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Marine Fisheries REVIEW

National Oceanic and Atmospheric Administration • National Marine Fisheries Service

FISHING FOR HERRING in SOUTHEASTERN ALASKA

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Mixed Species Utilization

DANIEL W. BAKER and STEVEN E. HULME

INTRODUCTION

Traditionally, in the New England trawl fisheries, that portion of the catch which is not considered marketable as food fish, due to the small size of the fish or the lack of an established market, is discarded, or in some cases is taken ashore for use as industrial fish in the manufacture of fish meal or pet food. These discards represent a sizable portion of the total catch (often as high as 20 to 30 percent) (Rathjen, 1974). In most cases where they are utilized as industrial fish, the handling practices are less than acceptable by human food standards.

In light of decreasing world food supplies, it is evident that the traditional species resource is being depleted beyond its capacity to regenerate and we can ill afford to continue to discard these underutilized species. Studies designed to assess the potential utilization of the many species now discarded and increase their availability by diverting fishing effort to this resource can relieve the pressure on the traditional resource and aid the industry in solving this problem. Improved methods of bulk holding made possible by the development of effective shipboard methods to enhance the preservation of mixed species and eliminate expensive shipboard handling will allow vessels to land large volumes of good quality, low-valued species.

Three methods of holding fish were considered other than the traditional method of icing, which presented unloading problems. They were: 1) refrigerated seawater using mechanical refrigeration and circulating brine, 2) refrigerated seawater spray requiring essentially the same equipment as in 1), and 3) chilled seawater (CSW) which uses seawater and ice to form a slush mixture requiring no mechanical equipment other than circulating pumps. The first two methods require costly equipment with the risk of mechanical failure, whereas the CSW method requires only ice and seawater in the proper proportion with little or no maintenance. A CSW system has been successfully used for herring in the United Kingdom for several years (Anonymous, 1972).

Recognizing the fact that commercial fishermen will not sort out small amounts of low-valued species from large mixed catches, it appeared possible that mixed species could be held in CSW to maintain quality at sea. Upon arrival at port the entire mixed catch could be sorted, saving substantial quantities of food-quality fish which would normally be discarded at sea or used for fish meal.

PRELIMINARY TESTS

Several tests were carried out in the Center to determine the effects of CSW on the quality of mixed species. Commercial samples of mixed species were held in an insulated tank in CSW. The results of these tests indicated that there appeared to be no detrimental effect on individual species when stored unsorted. All these tests showed that good quality could be maintained for several days.

SEA TRIALS

A commercial fishing trawler was chartered to do bulk holding studies of mixed industrial fish in CSW, and in ice for periods of 1 to 3 days (Tables 1 and 2). The vessel had an insulated fish hold which was divided into two separate compartments. One compartment was to hold fish in CSW, while the other compartment was to hold fish in ice in the traditional manner.

Baker

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Hulme

Table 1. — Date, time, and temperature (°C/°F) in the CSW mix on the 2 February 1975 cruise.

Pen no. and position of thermocouple	2/2/75 7 p.m.	2/3/75 9 a.m.	2/3/75 12 noon	2/3/75 6 p.m.	2/4/75 9 a.m.
	At sea	In port			
1 Top	1.1 34	0 32	0 32	−0.56 31	−1.1 30
Bottom	2.2 36	0 32	0 32	−0.56 31	−1.1 30
2 Top	−0.56 31	0 32	0 32	−0.56 31	−1.1 30
Bottom	0 32	0 32	0 32	−0.56 31	−1.1 30
5 Top	−0.56 31	0 32	0 32	−0.56 31	−1.1 30
Bottom	−0.56 31	0 32	0 32	−0.56 31	−1.1 30
6 Top	−0.56 31	0 32	0 32	−0.56 31	−1.1 30
Bottom	−0.56 31	0 32	0 32	−0.56 31	−1.1 30

Cruise data

Charter days	: 2
Date sailed	: 2 February 1975
Date caught	: 2 February 1975
Seawater temp.	: 4.4°C (40°F)
Ambient temp.	: <−1.1°C (30°F)
Date landed	: 3 February 1975
Date unloaded	: 4 February 1975
Weather	: Calm during the day, becoming extremely rough throughout the night and return.
Ice	: 3.2 metric tons (3.5 tons)
Total catch	: 6,804 kg (15,000 pounds) of mixed species

Table 2.—Date, time, and temperature (°C/°F) in the CSW mix on the 15 February 1975 cruise.

Pen no. and position of thermo-couple	2/15/75 8 a.m.	2/16/75 8 a.m.	2/16/75 3 p.m.	2/16/75 9 p.m.	2/17/75 9 a.m.	2/17/75 9 p.m.	2/18/75 9 a.m.
		At sea				In port	
1 Top		0 32	−0.56 31	−1.1 30	−0.56 31	0 32	1.67 35
Bottom		−0.56 31	−1.1 30	−2.2 28	−0.56 31	−0.56 31	1.1 34
2 Top	Loaded ice	1.67 35	1.1 34	0 32	0.56 33	0.56 33	2.2 36
Bottom	and caught	0 32	−0.56 31	−1.1 30	0 32	0 32	2.2 36
5 Top	fish	−0.56 31	−0.56 31	−1.67 29	−1.1 30	−1.1 30	0.56 33
Bottom		−0.56 31	−0.56 31	−1.67 29	−1.1 30	−1.1 30	1.1 34
6 Top		−0.56 31	−0.56 31	−1.67 29	−1.1 30	−1.1 30	0 32
		−0.56 31	−0.56 31	−1.67 29	−1.1 30	−1.1 30	1.1 34

Cruise data

Charter days	: 3
Date sailed	: 15 February 1975
Date caught	: 15 February 1975
Seawater temp.	: 4.4°C (40°F)
Ambient temp.	: 4.4°C (40°F) < 4.4°C (40°F) at night
Date landed	: 16 February 1975
Date unloaded	: 18 February 1975
Weather	: Fairly calm throughout
Ice	: 3.6 metric tons (4 tons)
Total Catch	: 9,435 kg (20,800 pounds) of mixed species

At the beginning of each cruise, in accordance with previous determinations, 3.2 to 3.6 metric tons (3.5 to 4 tons) of ice were put into the compartment for CSW holding. An equal weight of seawater was then added. This made a slush mix of sufficient quantity to hold 10.9 metric tons (12 tons) of fish.

Iced storage studies to compare the subsequent shelf life of fish held by the two methods were done after the 2 to 3 days of holding on the vessel.

RESULTS AND DISCUSSION

In order to insure cargo stability, it was necessary to fasten each pen board securely in place. However, it was also necessary to leave a gap at the bottom of each pen and drill random holes in the pen boards to assist in equalization and provide for slow circulation of seawater. Without water-tight partitions between pens, it was necessary to alternate loading the pens to insure even

Table 3.—Total plate counts (TPC) of microorganisms on fish held in CSW before and after unloading and on fish held in ice.

No.	Sample	TPC/ml
1	Seawater in hold	8.7×10^5
2	Seawater in hold	1.3×10^6
3	Fish in CSW	3.2×10^5
4	CSW fish after unloader	9.0×10^4
5	Iced control fish	1.5×10^6

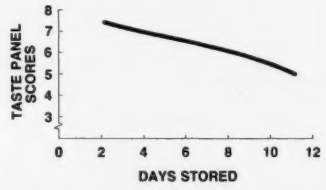

Figure 1. — Average taste panel scores for whiting in CSW.

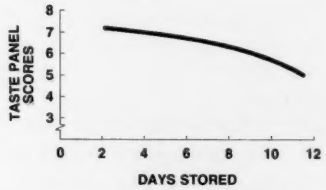

Figure 2. — Average taste panel scores for whiting in iced storage.

Figure 3. — Average taste panel scores for red hake in CSW.

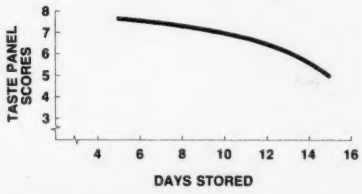

Figure 4. — Average taste panel scores for red hake in iced storage.

distribution and to minimize the possibility of displacing the water from a pen by overloading it.

A ratio of one part ice to one part of seawater to three parts fish by weight had previously been worked out in the United Kingdom. These ratios provided enough ice to lower the fish temperature to the desired range—enough to last the required time while holding the desired temperature range and still provide a workable slush mix into which the fish were placed (Anonymous, 1972). In our studies, we conformed as nearly as possible to these relative ratios. Temperatures were more uniform during rough weather than during calm weather due to effective, natural mixing.

Iced storage studies were conducted with samples taken from a number of trips of 2 and 3 days duration, and organoleptic evaluations were made throughout the iced storage life of the samples. Whiting and red hake were both used for evaluations, as they were the two most prevalent of the mixed species. Figures 1 and 2 compare average taste panel scores on a 9-point hedonic scale of whiting held in CSW and then stored in ice with those of whiting stored in ice only. Figures 3 and 4 show the same comparison for red hake.

Statistical analysis of the taste panel results showed no significant difference between the spoilage rates of the fish held in CSW and the fish held by traditional means.

Microbiological tests on samples from a trip where a vacuum unloading pump was used to discharge the catch showed no appreciable difference in total plate counts between fish held in CSW before and after pumping and fish held in ice (Table 3).

The appearance of CSW fish taken out of storage after 2 or 3 days was excellent. Their surfaces were bright with good color, the eyes were clear, and the fish appeared to be in rigor. There was no extension of shelf life beyond that of the traditionally held fish.

As a consequence of their being agitated during rough weather, the fish were scaled prior to landing and, because of this, did not readily meet market acceptance standards for fresh whole fish. However, scaling does not appear to have a detrimental affect on the product and these fish could be used for additional processing.

CONCLUSIONS

Fish held in CSW are more readily unloaded by pumping than by the traditional basket method. They can also be more economically separated after landing than at sea.

Sea trials resulted in superior quality fish, by visual observation, with shelf life equal to that of traditional icing, therefore proving several advantages to the CSW method. The only questionable disadvantage was the scaling that occurred in rough weather.

ACKNOWLEDGMENTS

The authors express their gratitude to the Pt. Judith Fishermen's Cooperative Association, Inc., and Frank Lamy and crew of the *Jerry and Jimmy* for their cooperation and help throughout the project.

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MFR PAPER 1238

Chilled Seawater System for Bulkholding Sea Herring

STEVEN E. HULME and DANIEL W. BAKER

INTRODUCTION

The sea herring, *Clupea harengus harengus,* is one of the most intensely harvested stocks in the northwest Atlantic. The herring has traditionally been a highly prized species for food and a number of industrial products such as oil, fish meal, and pearl essence. The harvesting of juvenile herring for canned sardines supports some 16 plants in the state of Maine alone. Tht total annual catch of sea herring in the northwest Atlantic by all nations has averaged 295,400 metric tons (650 million pounds) from 1972-74[1]. Of this, U.S. fishermen landed 32,680 metric tons (71.9 million pounds) in 1974 valued at $2.6 million (Statistics and Market News Division, 1975).

Much of the U.S.-landed herring is presently used for industrial fish rather than food fish primarily because of quality. Lack of adequate storage techniques for herring being transported from the fishing grounds and inadequate means of holding herring once landed add to the reduction in herring quality.

Extremely large catch performances make it virtually impossible to preserve them by traditional icing practices; therefore, fish must be returned to port as quickly as possible to avoid excessive spoilage. During the summer months, deterioration of the fish is so rapid that travel time from the fishing grounds is reduced to a maximum of 5-6 hours to ensure fish of food quality.

Another consideration is that of overland transport. Large quantities of herring are transported considerable distances to processors in order to maintain operation during herring migrations. Presently, the method of transport is an open dump truck or tank truck with no means of icing used during transportation. The time lapse between catching and final processing may be as long as 12 hours, depending on the distance traveled and quantity of fish.

Considering the unusually rapid spoilage rate of herring, it is ideal to chill the product rapidly before the onset of bacterial degradation and autolysis. In a study by Merritt (1974) on the stability of herring in relation to treatment before freezing, the immediate chilling at 0°C (32°F) for 32 hours before freezing produces 75 percent first class fish as compared to 33 percent for herring unchilled for 8 hours on the catcher vessel.

Spoilage rates are directly related to storage temperature. Banks (1966), comparing spoilage rates of herring stored at 0°C (32°F) with spoilage rates at various temperatures, observed that fish spoiled 2.5 times faster at 6°C (42°F) and 5.5 times faster at 11°C (52°F). The relationship between temperature and spoilage rate indicated the importance of rapid chilling on the maintenance of quality.

Estimates made by the New England Fisheries Development Program (NEFDP) have shown that increased herring utilization for food could benefit the U.S. fishery greatly. Earl[2] estimated an added value of $1.6 million if all of the 1974 U.S. herring quota for the northwest Atlantic was processed as food.

One potential area for improvement of fish quality aboard ship as well as on land is the use of chilled seawater (CSW), a mixture of ice and seawater for holding the fish. Sea trials carried out by the National Marine Fisheries Service's Northeast Utilization Research Center (NURC) using CSW for mixed species indicated that several species including herring could be held for several days while maintaining excellent quality (Baker and Hulme, 1977). Extensive work has also been carried out in Great Britain on CSW holding of herring (White Fish Authority, 1972; Karsti and Blockhus, 1966; Merritt, 1974; and Hewitt and McDonald, 1972). This holding method requires limited mechanical equipment and is adaptable to both bulk systems and containerization.

PREPARATIONS FOR TESTING

Bulk Tank System

In the spring of 1975, the *Lady Esther III,* a 35-m (115-foot) vessel previously used as a carrier for herring seiners, was outfitted with a prefabricated, insulated afterhold and a CSW circulation system.

The bulk tank is a single unit, subdivided longitudinally to form two separate holds, each approximately 39.6 m^3 (1,400 $feet^3$), capable of carrying 27,200 kg (60,000 pounds) of herring with ice and seawater. The tanks are constructed of plate steel, insulated outside by 7.62 cm (3 inches) of spray-on polyurethane foam and overcoated with two 0.635 mm (25 mil) thick layers of butyl elastomer. The interior is sandblasted, primed, and coated with vinyl.

The circulation system, constructed of 7.62-cm (3-inch) polyvinyl chloride (PVC) pipe connected to two diesel-powered, self-priming pumps, allows adequate flexibility in operations. Water from the seacock is routed through a perforated lower return line for initial filling with seawater. A perforated high suction line located around the top border of each tank allows the CSW to be drawn off and recirculated through the lower return line during circulating operation. Each tank is also equipped with a low

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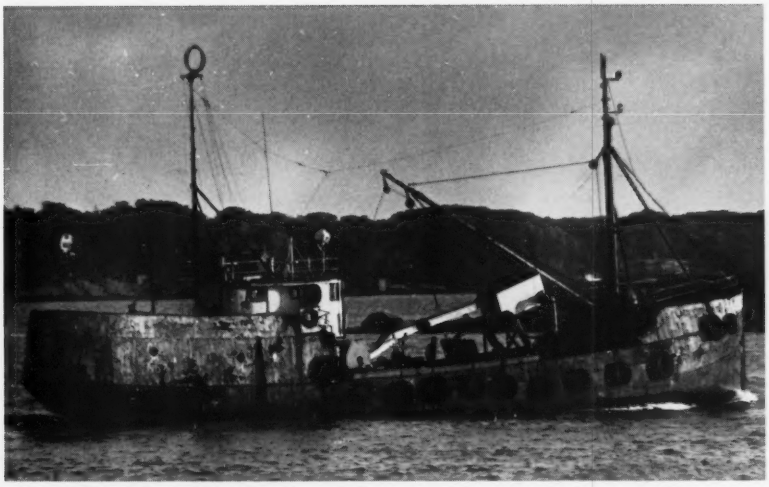
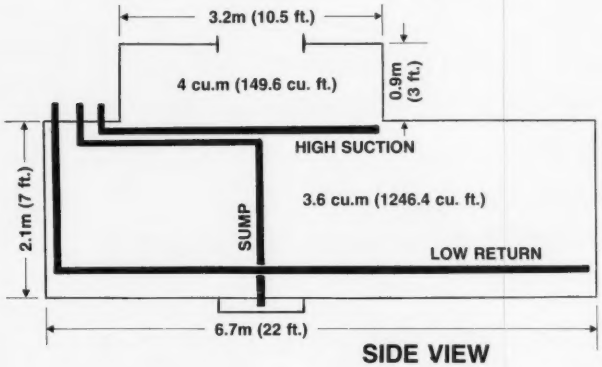
[1]Gordon, W. G. 1975. Outcome of ICNAF meetings, Edinburgh, Scotland. Unpublished.

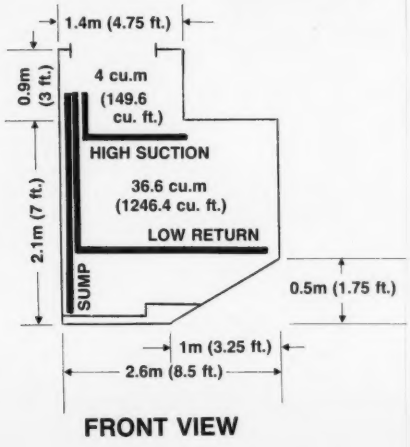
[2]Earl, P. M. 1975. New England Fisheries Development Program Progress Report. Unpublished. 16 p.



The *Lady Esther III* herring carrier steaming out of port for an all-night seining operation.

Figure 1.—Bulk tank dimensions and piping diagrams.





suction (sump) to be used in draining the tanks or as an aid to circulation of CSW. A separate hatch cover is provided for each hold permitting adequate access for loading and unloading of ice and fish. Figure 1 shows the diagram of the bulk-tank system.

A multipoint strip chart recorder was mounted in the wheelhouse for recording temperature data during sea trials. This was connected to two 9-element copper constantan, thermocouple cables, each located in separate holds (starboard and port). The elements were located in various places within the hold (to give an accurate record of the temperature distribution). Flow meters installed on the output side of each pump indicated the approximate flow rate during circulating operation. The quantity of seawater added to the ice in each hold was critical for the evaluation of the system. For this reason, a water meter was installed on a bypass line located on the output side of the starboard pump. The valve system allowed filling of either hold section through the meter.

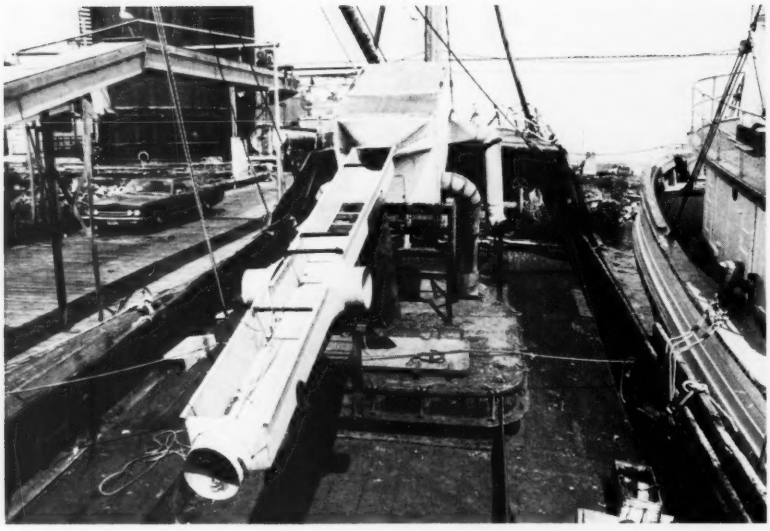
Containerization

For the containerization studies, four Tote System[3] containers measuring 2.3 m (7.5 feet) in height and 1.2 m (4 feet) by 1.1 m (3.5 feet) in width were obtained commercially. These containers were aluminum-skinned with one container insulated by 7.62 cm (3 inches) of polyurethane and the other three with 5.08 cm (2 inches) of polyurethane and a capacity of 1.91 m^3 (67.6 $feet^3$) and 2.12 m^3 (74.7 $feet^3$), respectively. Each container was provided with a hinged hatch cover and a drain plug for cleaning. During testing, circulation in the container was provided by compressed air at 5 psi forced through a 0.64-cm (0.25-inch) diameter outlet located in the bottom of each container. The air flow rate was about 1.6×10^{-3} cm^3/second (3.35 cfm). The containers were held on the deck of the vessel during the trials and loaded and offloaded by means of a crane.

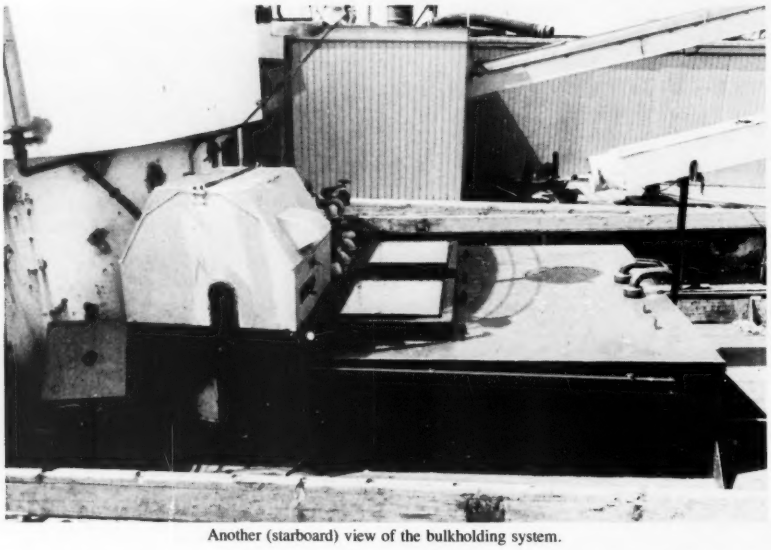
PROCEDURE

The optimum amount of seawater was determined for the bulk tanks before starting the investigations. Before each test, crushed

[3]Mention of a commercial company or product does not constitute an endorsement by the National Marine Fisheries Service, NOAA.



Dewatering box and chute system on the *Lady Esther III* used in typical New England herring seining operations.



Another (starboard) view of the bulkholding system.

block ice was loaded in each hold. Quantities of ice were varied using 3.6, 4.5, 5.4, 6.4, and 8.2 metric tons (4, 5, 6, 7, and 9 tons) of ice in separate tests. Seawater was added to the tanks after reaching the fishing grounds and 3,785 liters (1,000 gallons) of seawater was constant for all ice quantities in the bulk tank system. Seawater drawn through the seacock was pumped through the water meter which accurately measured the amount of water added to each hold.

The containers, located in the mid-deck area, were loaded with ice at the same time as the bulk tanks. Ice quantities used were varied while the seawater quantity remained constant at approximately 189 liters (50 gallons) per container. Temperature of the seawater added to the CSW systems and the ambient temperature were recorded.

No further operations were necessary from this point until the fish were caught and loaded. The fish were pumped out of the seine to a dewatering box located on the vessel. A chute system conveyed the fish directly into each hold. Fish were alternately loaded into both bulk tanks and containers to permit adequate mixing of the fish in the ice mixture. When each tank was filled to capacity, the fish were given a short time to settle within the slush. The remaining portion of the catch was loaded into the forward hold which was held in the traditional manner without ice. Internal temperatures of the fish and temperatures of the CSW at various points were recorded immediately after loading with fish. Once the fish had settled within the tanks, circulation at a rate of about 120 gpm was started. The temperature of the water at various points in the tanks was taken at half-hour intervals until it stabilized. Once the temperature stabilized throughout the tanks, circulation was turned off and checked periodically until offloading. Temperature data were taken at intervals during the trial to observe the maintenance capabilities of the system.

Fish were offloaded from the bulk tanks in the usual manner with a centrifugal suction pump and on one occasion with a pneumatic Temco pump. Samples from the CSW were removed and placed on ice along with control samples from the forward hold for extended shelf-life studies, organoleptic evaluation, and bacteriological plate counts carried out at the NURC. The containers were lifted off the vessel by means of a crane and placed on a truck for transport to a Maine canning company. After arrival, the fish remained in the containers for 60 hours, and fish temperatures were recorded periodically until unloading. Control samples were shipped in saturated brine for comparison of quality.

RESULTS AND DISCUSSION

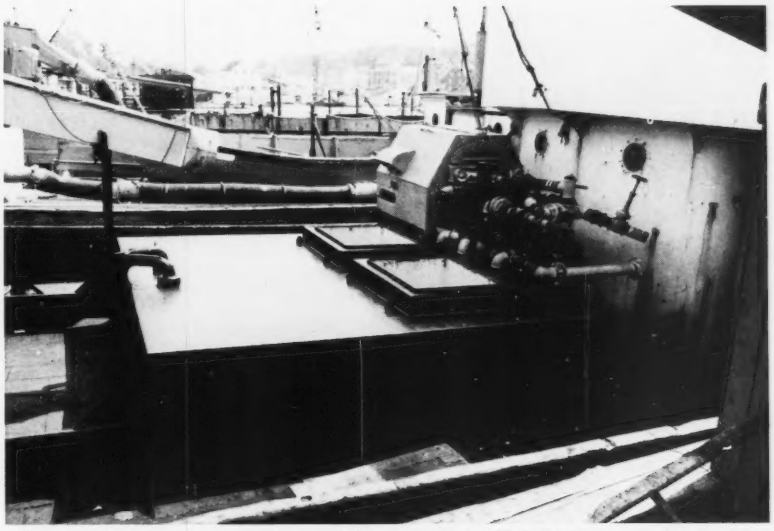
Several problems with the CSW system were encountered during the sea trials. The first difficulty involved the slush preparation. On the first tests, ice was loaded into the tanks and addition of seawater was delayed until the fish were actually being drawn up in the seine. The slush preparation was adequate as long as the fish were caught and loaded shortly after the ice was loaded, but occasionally 2 or 3 days elapsed before the fish were located. During that time, the ice within the tanks began to fuse, forming

agglomerated ice masses which complicated the loading, offloading, and circulation procedure. It was found that agglomeration of the ice could be significantly reduced if seawater was added as soon as possible after the loading of ice. Maintenance of the slush was quite effective using this method; in fact, on one occasion the slush was maintained for 3 weeks before the fish were finally loaded.

The design of the bulk tank allowed adequate circulation provided the herring settled in the tank water and ice. Occasionally, the fish did not settle within the slush upon loading, rendering circulation impossible because of clogging at the high suction line. This problem was remedied by attaching a rubber fire hose to the pump discharge and drawing water from the bottom of the tank (sump) and redirecting it through the fire hose through the hatch opening which initiated settling within a matter of minutes. Occasionally, when water was pumped from the sump with a full load of fish in the hold, the fish tended to compact around the sump grate and stop the flow of water to the sump. To increase the area of drainage and provide a more continuous flow of water to the sump, a standpipe leading from the sump grate to the top of the tank was constructed of 7.62-cm (3-inch) PVC with a random series of slit-type openings throughout its length. This provided an additional flow of water to the sump area and prevented clogging of the grate.

After these difficulties were overcome, the system was capable of stabilizing temperatures in the tanks within a 4- to 6-hour period. Temperatures of fish taken from various parts of the tank were within 1-2°C (1.8-3.6°F) of the temperature of the CSW mixture indicating effective heat transfer. In subsequent testing of the CSW system, stabilization temperatures were plotted against quantities of ice (Fig. 2). These are based on the average CSW temperatures recorded—average seawater temperature of 17°C (62°F) and air temperature of 24°C (75°F)—versus the time of holding.

Temperature maintenance of the system was a key factor in the overall efficiency of the system. Fish were held for a maximum of 32 hours before unloading and examining their quality. Upon examination, the quality of CSW herring was visually better than the quality of those taken from the forward hold without ice. Lack of bleeding or autolysis and firmness of the fish itself were evident.



Port view of chute, hatch openings, and pump and piping arrangements of the bulkholding system. Only the upper portion of the bulk tanks is shown; the remainder is below deck.

The efficiency of the bulk tank system is largely due to the configuration of the tank. The smaller upper portion of the tanks made it possible to limit the amount of excess water required for circulation. In British experiments with the CSW system adapted for containers, the ratio of seawater to ice to fish was 1:1:3. Because we were dealing with a bulk system, making maximum use of the space available, the proportion was approximately 1:2:7 for attaining a stabilization temperature of 0°C (32°F).

Optimum temperatures of −1°C to 0°C were reached using a mixture of 6.4 metric tons (7 tons) of ice and 3,785 liters (1,000 gallons) of seawater at 17°C (62°F), although lesser quantities of ice were used for extended holding periods. However, adequate holding temperatures can be achieved with lesser quantities of ice for relatively short, one-night fishing trips, as is the practice with many New England herring boats.

All of the herring caught on these sea trials was processed in commercial plants. Comparisons made on consecutive days between CSW fish and traditionally held fish indicated an increase in the overall yield (Table 1) for the CSW fish. Most noticeable was the condition of the fish upon entering the plant. As there were no plant facilities for storing the catch after the fish were unloaded, all fish, both non-iced and CSW-treated fish, underwent the same process. The CSW fish, unlike those held without ice, did not appear to show any signs of

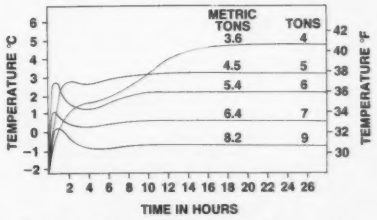


Figure 2.—Relationship of various ice quantities used and the subsequent stabilization temperature attained over a period of time.

Table 1.—Plant production data.

Product	Control (non-iced) kg/lb	% yield	CSW treated kg/lb	% yield
Gross input Herring	63,518 140,000	—	39,164 86,340	—
Fillets	26,762 59,000	42.13	17,962 39,520	45.77
Roe	177 390	0.28	204 450	0.52
Milt	195 430	0.31	168 370	0.43
Discards	36,383 80,210	57.28	20,866 46,000	53.28

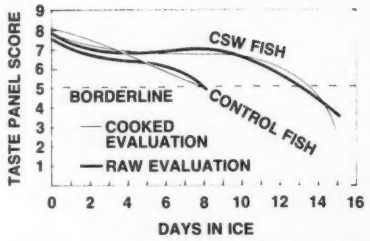


Figure 3.—Average taste panel scores (9-point hedonic) vs. subsequent iced storage time.

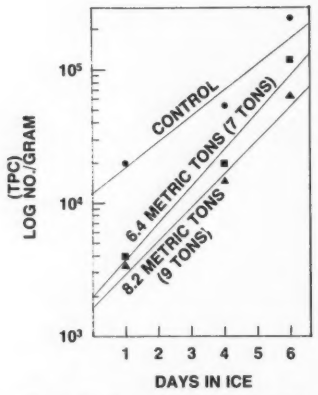


Figure 4.—Comparison of total aerobic counts of CSW fish vs. control fish during subsequent iced storage.

autolysis (popped belly) upon reaching the production line. The relative firmness of the CSW held fish upon reaching the filleting machinery reduced the number of discards produced by the cutting machines. Observations of the process revealed a dramatic decline (at least 50 percent) in the number of poorly cut tails with the CSW fish as compared to the softer non-iced fish. Firmness of the fish also had a direct effect on the increased number of whole, unbroken milt and roe sacks, which accounts for the lower yield obtained from non-iced control fish in which autolysis occurred.

CSW held fish and control samples from the forward hold were boxed and iced upon return to the NURC. Every 2-3 days, a number of specimens in the raw and cooked state from each lot were examined by a taste panel.

Results (Fig. 3) indicate the initial quality of the fish before being placed on ice to have an effect on the shelf life by 5 days when compared to the non-iced fish. Total aerobic plate counts were made to determine the degree of spoilage in chilled and unchilled herring during the 4-5 hour holding time on board the vessel. Results shown in Figure 4 indicate the advanced state of bacterial growth in the control fish.

Container System

The containers for holding herring were tested for their practical value in overland transport. With one test using 299 kg (660 pounds) of ice and 189 liters (50 gallons) of seawater, the quality of fish unloaded 60 hours later was excellent compared to the herring shipped in brine which was spoiled in 24 hours. The circulation system of compressed air for the containers did manage to keep the temperature within the tanks fairly uniform, within 2-4°C (3.6-8°F), although not as well as in the bulk tanks where water circulation was used and the temperature variation was lower.

A preparation of ice and seawater for the storage of herring on the vessel proved effective for overall quality maintenance and in increasing the percentage yield of food-quality sea herring. In general, the CSW system was simple to use and was extremely dependable.

Previous studies performed with herring held in mechanically refrigerated seawater (Meyboom and Van Pel, 1965) showed a permanent red discoloration of the tissues around the belly cavity and the backbone after 5 days. The discoloration was obviously caused by blood or blood components and could not be removed by washing. It was found through further investigation that the salt content of the storage medium influenced the red discoloration in that the higher the salt content, the higher the intensity of the discoloration. Our results indicate that the lowered salt content in CSW could delay this phenomenon.

The design of the bulk tank system was quite effective for use with CSW. The bulk tank is capable of holding sufficient quantities of fish for several days. There is, of course, some reduction in holding capacity but the marketability of the product more than compensates for this loss.

Piping diagrams as shown in Figure 1 indicate the arrangement used throughout the testing procedure—at completion, only one modification was necessary. Raising of the high suction line into the upper portion of the tank could facilitate more rapid circulation of CSW with a decrease in obstruction by unsettled fish. This would also place the high suction line in closer proximity to the ice and seawater consolidated at the top of the tank.

Sufficient testing could not be done with the containers to determine economic specifics, although the overall design of the containers tested was adequately suited to storage and transport procedures. Success of the container system lay primarily in the fact that fish are chilled more rapidly and with less effort than in ordinary icing procedures. Other advantages include: 1) Ease in offloading and transport; 2) Maintenance of quality storage for overland transport; and 3) Less overall handling.

The major drawbacks of containerization are the additional space requirements and reduction in vessel capacity, as well as the cost of large numbers of containers and complete handling systems at dockside and in processing plants. These factors have to be weighed against the improved handling which could bring a higher market value.

The sea herring industry involves a dual system. Those fish considered good are used for food purposes and command the highest market value; the remaining fish are used for industrial purposes. Many times, perfectly good quality fish will be diverted to fish meal because of a surplus and inadequate means of storage.

On a number of occasions, observations were made of the quality of fish waiting to be processed. Unchilled fish often arrive in an advanced state of autolysis. By the end of an 8-hour working day, the fish have become progressively worse, leading to reduction in the filet quality. Even chilled herring can begin to lose their firmness approximately 5 hours after unloading when ambient temperatures are about 18-21°C (65-70°F). After such time, the belly linings begin to soften and break open and the fish quickly lose their firmness.

Currently, there is a lack of adequate equipment for the handling of fish during the processing procedure. It may be advisable that holding tanks prepared with ice and seawater be established in the receiving process. This would allow continual chilling of the herring until such time as they are ready to be cut. Also, a waterless pump could be used in the unloading process to eliminate the use of warm water to remove the fish from the vessel. Such a pump was

demonstrated with very good results not only in unloading capacity but in the handling of the fish without physical damage. The CSW could be reused for dockside holding or overland transport with the added benefit of a reduction in waste water volume.

SUMMARY

The results of the tests on bulkholding of herring in CSW indicate several advantages over normal industry practices. Benefits to the fishermen would include: 1) The ability to take advantage of herring stocks further from port; and 2) Increased revenues by landing food-quality fish at higher prices.

Potential benefits to the processing sector would be: 1) Increased production yields; 2) The ability to transport fish long distances without quality loss; and 3) More efficient use of plant facilities by holding surplus fish for longer periods, leveling production, and maintaining operations during periods of inclement weather.

ACKNOWLEDGMENTS

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Special thanks is extended to the crew of the *Lady Esther III* for their help throughout the entire project.

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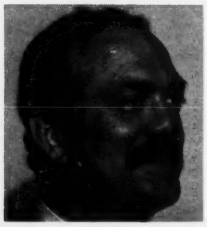
MFR PAPER 1239

The Southeastern Alaska Herring Fishery

HOWARD O. NESS



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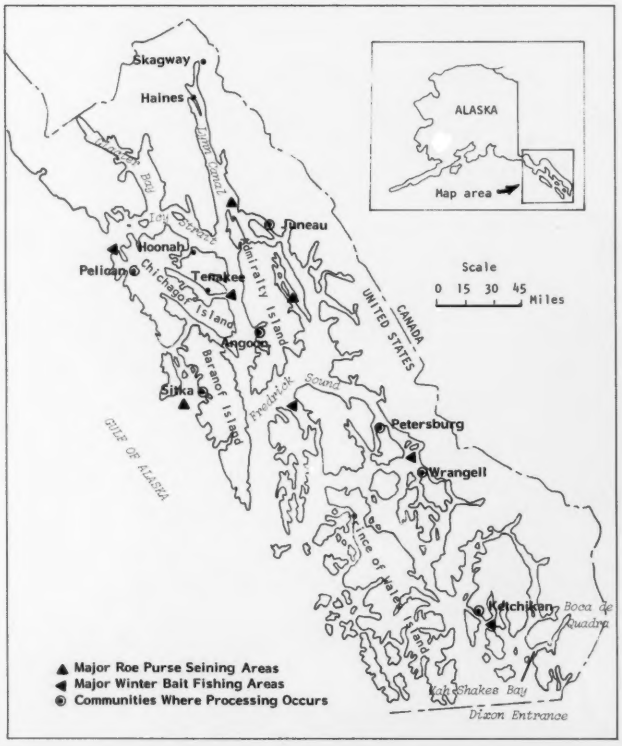
Many southeastern Alaska salmon fishermen were in trouble in 1975. Because they were plagued with low salmon runs and increased operating costs, some fishermen actively sought participation in additional fisheries.

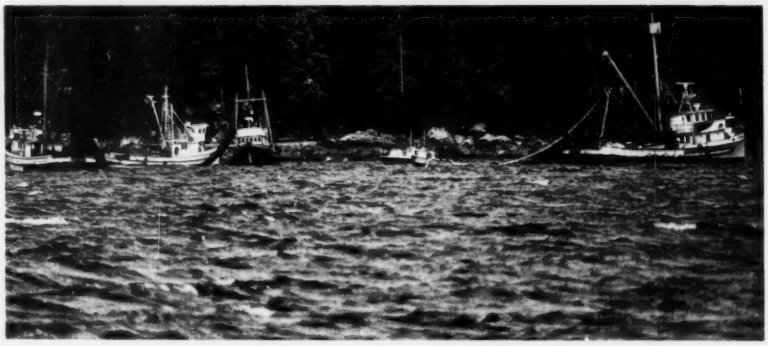
Diversification in a winter herring fishery for food and bait products and spring herring fishery for sac roe helped some southeastern Alaska salmon purse seiners out of a severe financial crunch. Today there is increasing evidence that the further development of a spring and winter herring fishery could provide an economic boost to this depressed industry.

Assuming a constant demand for herring products and a sustained availability of the resource, there is growth potential for the herring industry in southeast Alaska. Dependent upon the location of the processing plant, presently about 6-14 percent[1] of all southeast Alaska processing labor is devoted to herring production. The total employment during the peak of the herring roe fishery totals about 188 in processing

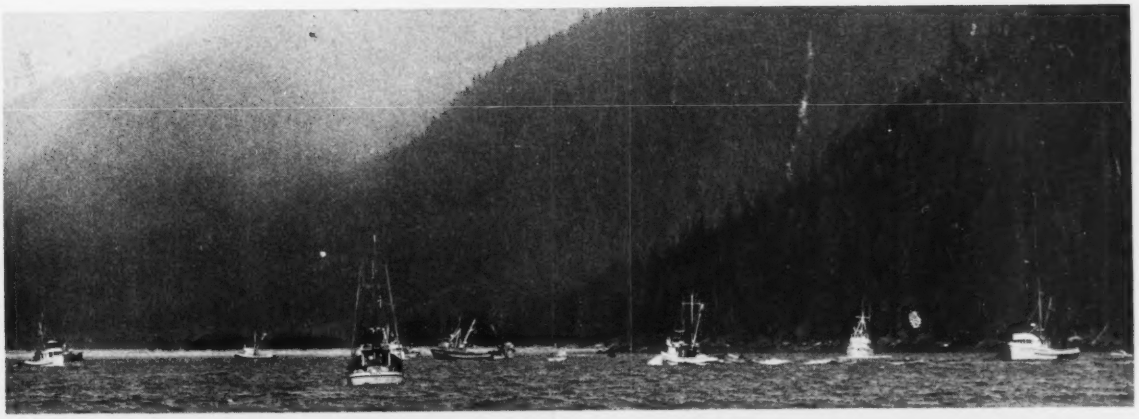


Major herring fishing areas in southeastern Alaska.

Purse seiners "setting" near Juneau, Alaska.



[1]Estimated in man-days. Actually, during the months of May, October, and November, well over one-half of the processing labor force is involved in processing herring. Rogers, G. A Study of the Socio-Economic Impact of Changes in the Harvesting Labor Force in the Alaska Salmon Fishery. University of Alaska, NMFS Contract 1-360-079. 6 February 1973.



Some of the activities involved in a herring roe fishery about 25 miles north of Juneau in April 1975 are shown here.

In scouting for herring (top), sonar fish finding gear is being used to locate schools. Herring is caught (middle). Three boats have made their sets and are bringing part of their nets aboard in preparation for brailing.

A "Japanese brailer" is used (right) to load the catch into the tender. Single hauls of over 200 tons worth $35,000 have been reported.

and 150 to 180 individuals in fishing and tendering. The winter herring fishery employs approximately 136 in processing and 56 in fishing and tendering. The present industry contributes an estimated monetary benefit of over $2 million annually to the economy of southeast Alaska.

Herring fishing trip costs are not excessively high. Roe herring fishing expenses, excluding crew shares, average $700-$1,000 per boat. Over 90 percent of the spring roe herring purse seine fleet at least recovered their operating costs. The fixed cost of mortgage payment continues irrespective of the boat's fishing activity and spring herring fishing offers an opportunity to recover some of this fixed investment. The costs of investment in herring fishing gear may not be covered for any given season and the forfeited opportunity to work in other occupations (opportunity cost) should

Herring roe containers are topped off with salt before being sealed for export to Japan.

Extracting herring roe.

be considered. However, if the vessel's crew makes a successful set while fishing for roe herring there can be high net returns to the operator after operating and labor costs are subtracted.

The estimated average costs and returns of southeastern purse seiners in both salmon and winter herring fishing are illustrated in Table 1. A winter herring seine operator can more than cover his fixed and capital costs, estimated at $12,000 to $15,000. Earnings returned in the winter herring seine fishery averaged about $24,000 per vessel in 1974-75.

Probably more than 50 percent of the 371 southeastern Alaska purse seine vessels are valued in excess of $125,000 each. Some of the newer vessels in this fleet are valued at more than $200,000. Several of the 30 purse seine operators that fish for herring own the newest and best equipped boats in the entire fleet. The Alaska Commercial Fisheries Entry Commission determined that approximately 46 percent of this fleet's gross earnings were made in fisheries other than salmon fisheries[2].

[2]Alaska Commercial Fisheries Entry Commission. Costs and earnings of Alaskan fishing vessels—an economic survey. 10 September 1974.

The purse seiners' estimated average gross revenue in 1973 was $80,000 for all fishing activity. Fifty-four percent of this can be attributed to salmon fishing. Receipts from herring fishing have accounted for the remainder of the annual gross receipts from fishing for at least 10 percent of the southeastern Alaska resident purse seiners, helping some southeastern seiners out of a severe financial crunch in years when fishing costs have greatly escalated. Also, southeastern pink, chum, and coho runs suffered record low returns in southeast Alaska in 1975.

To diversify into herring fishing, fishermen in southeast Alaska can outfit their salmon purse seine boats with a herring seine for approximately $20,000-$25,000 and electronic "fish finding" gear for $7,500-$15,000.

Processors favor an immediate expansion in the spring herring roe fishery because this fishery has proven to be highly profitable and expansion requires little increase in facilities and investments. Estimated in man-days, during the months of May, October, and November well over half of the processing labor force is involved in processing herring. It was apparent from interviews with processing plant managers that almost all of the plants in southeast Alaska have processing expansion capability for both spring sac roe and winter herring processing.

HERRING ROE PROCESSING

Southeastern Alaska processors most certainly view the spring roe fishery as a necessary segment of their gross sales. In fact, this fishery was a needed "shot in the arm" for some southeast Alaska processors who, in 1974-75, were suffering from one of the most depressed worldwide seafood markets in years.

Since the final destination for the product is Japan, the processing activity begins on the grounds where Japanese technicians examine samples of herring to determine the stage of ripeness, a vital factor that determines both the processing efficiency and roe quality—the herring carcass must yield from 12 to 20 percent roe by weight. Roe yields are dependent upon the female-male sex ratio, age, race, and roe maturity. When the technicians find that the herring have reached the appropriate degree of roe maturity, which changes just prior to spawning, the season is opened.

Table 1.—Estimated costs and earnings of southeast Alaska salmon purse seining and winter herring fishing[1].

	Salmon	Herring
Vessel Characteristics		
Age	35	35
Keel Length	47	47
Engine horse power	202	202
Diesel (%)	96	96
Outboard (%)	0	0
G. inboard (%)	4	4
Electronics		
Radar (%)	76	76
Loran (%)	20	20
Auto pilot (%)	36	36
Est. mkt. value of vessel	75,780	75,780
Est. mkt. value of gear	15,432	23,000
Vessels insured (%)	96	96
Number of crew (incl. skipper)	6	6
Operatings costs		
Fuel	1,147	1,381
Food, clothes	1,002	1,206
Bait	0	0
Ice	0	0
Total	2,149	2,587
Fixed costs		
Vessel repairs	2,408	2,051
Gear repairs, losses	2,313	1,970
Insurance	1,041	887
Moorage	74	63
Utilities	14	12
Administrative	208	177
Freight-transp.	402	342
Other	412	359
Total	6,872	5,861
Capital Costs		
Depreciation	1,258	1,072
10% interest charge on all investments	4,955	4,221
Total	6,213	5,293
Labor costs		
Crew labor cost	18,966	15,886
1973 average earnings	38,059	32,421
Plus: bonus payments at 19.6%	7,445	
Total earnings	45,504	32,421
Less: operating costs	2,149	2,587
fixed costs	6,872	5,861
depreciation	1,258	1,072
labor costs	18,966	15,886
Total costs	29,245	25,406
Net return	16,259	7,015
Less interest charge on investment	4,955	4,221
Return to operator	11,304	2,794

Source: Alaska Commercial Fisheries Entry Commission and the National Marine Fisheries Service.

During the fishing period, tender boats brail and load the herring from the seines. The herring are transported to the processor where they are loaded and cured for 3-4 days in bins containing a 10 percent brine solution. Some are frozen for future processing. Both the brining and freezing allow easier roe extraction after the product has been stored.

After curing, the roe is extracted from the carcass by hand squeezing. The roe is then placed in a 100 percent brine solution, drained, inspected, graded, and packed into cartons destined for the Japanese market. The carcasses are reduced into meal and oil[3]—herring meal is currently used as an animal feed additive and packaged into 100-pound bags. Spring herring yield about 20 percent meal by weight and 60+ percent protein.

Herring roe processing production is often dependent upon fishing skill and luck because there are instances of boats fishing for processing firms that unfortunately do not make successful sets. The herring roe processing activity in 1975 was clearly limited to fishing success and harvest levels, and not market demand for the products.

SPRING SAC ROE FISHERY

Today, in terms of gross returns per season duration, the herring roe fishery is one of the most valuable in the world. In April 1975, during a one day opening in the Sitka district lasting a total of 1½ hours, over 1,500 tons of herring were landed, valued at over $270,000 ex-vessel[4] and approximately $675,000 after the roe was extracted.

The same fleet, comprised of 26 purse seine vessels valued at over $3 million, were attracted to the Juneau area opening off Eagle Beach. This concentration of fishing effort focused on an allowable harvest of 550 tons of herring valued at $99,000 in the net. The 2½-hour fishery also attracted 9 tender boats, valued at an additional $1 million-plus, that would land and transport the herring to the processing plant where the revenue from the finished product would be in excess of $275,000. The 1975 southeast Alaska roe fishery lasted 4 hours and grossed over $365,000 for 26 vessel operators.

Most of the vessels that participated in the 1975 roe fishery landed herring. The seiners in the Sitka opening were, in varying degrees, successful while in Juneau, about half of the 26 vessels made successful sets. The catch per boat in both openings ranged from less than 1 ton to over 200 tons. The average catch per boat for the season was just under 81 tons.

The herring roe fishery is extremely intensive. At times the fishing effort has been concentrated in an area no larger than 300 surface acres. In the 1975 season most fishermen did not have time to make more than two sets during any given opening. Alaska Department of Fish and Game personnel must work fast to monitor the fishing until the estimated allowable quota is reached, sometimes in less than 90 minutes.

The economic aspects of the spring roe herring fishery at first appear questionable, particularly inasmuch that this fishery is undergoing severe public criticism. Gear operators who participate in this fishery represent 8 percent of the 371 vessels in the southeastern Alaska salmon purse seine fleet. They will offer varied opinions about the roe fishery, opinions probably influenced greatly by their past successful participation.

Individual fisherman's returns in this fishery can be very high. During the 1975 opening in Sitka, a boat landed 200 tons of herring valued at approximately $36,000 in a single haul. There were some boats that fished the Juneau opening that did not land any herring. This boom or bust characteristic of the herring roe fishery has led to many proposals designed to limit participation in the spring herring seine fishery. In past years such proposals have been adamantly rejected by some fishermen who prefer the competitive nature of the industry. However, a recent scheme designed to limit new entrants into this fishery has been wholeheartedly accepted by the existing purse seine operators.

During the 1975 spring herring sac roe season, 130 fishermen on 26 purse seine boats landed 2,148 tons of roe herring having an estimated average ex-vessel value of $387,000. Six tender boats employing 19 tendermen delivered and unloaded the product to processors in five southeast Alaska communities. The final wholesale value of the roe product was in excess of $1 million. Approximately 188 individuals processed this product for an average of 9 days (20 days for roe extraction), for a total period of 2,810 man-days. The total roe herring processing payroll was an estimated $140,500.

[3]The reduction process only occurs at the Petersburg Fisheries Plant, Petersburg, and at the Seward Fisheries Plant, Seward, Alaska.

[4]After price adjustments are made by some processors, this value will increase.

WINTER BAIT FISHERY

The winter herring fishery currently appears to be limited by the demand for bait herring, much of which is marketed in Seattle and sold to Alaska king crab fishing boat operators. Also, Alaska herring fillet marketing is undergoing development and has not yet reached full potential.

An additional limiting factor on the southeastern winter herring fishery is the lack of sophistication in herring stock assessment and prediction techniques. Processors find it difficult to make pre-season management and investment decisions based upon information derived from the existing assessment techniques.

The 1974-75 southeast Alaska winter herring fishery involved 12 boats and employed 60 individuals. Two tenders were also involved; 11,805,000 pounds of product were landed, valued at $295,125 ex-vessel, and in excess of $1 million for the wholesale value for all the finished products. The total southeast Alaska winter herring processing labor force was an estimated 136 individuals who worked a total of 6,229 man-days and earned wages totaling $152,000.

In summary, it is apparent from the above income estimates for both fisheries that although the herring roe fishery is short in duration, it is extremely labor intensive in that processing labor earnings were not substantially less than income earned in the winter herring fishery. The average vessel operator's earnings from the roe fishery were greater, $14,580 compared to $12,700 averaged in the winter bait fishery, although there were almost three times the number of boats participating in spring fishing. It should be noted that vessel operators in the winter herring fishery, in areas where the major production occurred, had average gross earnings of over $25,000.

The conclusion should not be reached that the roe fishery is more valuable to the overall economy than the winter herring fishery in southeast Alaska because employment sustained over a long time period can result in more economic benefits than short-term intensive employment.

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MFR PAPER 1240

The Recent Development of the Southeastern Alaska Herring Fishery

HOWARD O. NESS

High commercial salmon catches are not among recent Alaskan brags. It's no secret that the state's commercial salmon fisheries have been plagued by declining runs and escalating operating costs.

The commercial fishing industry has become the victim in this escalated production cost-depressed supply squeeze. Hatchery enhancement and rehabilitation schemes have been proposed and funded, but these are, at best, long-range attempts at increasing salmon production.

What the salmon industry has needed is diversification into alternative fisheries, and new markets for fish production that would require minimal change and investment in existing gear and production techniques. The development of the spring and winter herring fishery could provide immediate relief in giving an economic boost to this depressed industry.

To diversify into herring fishing, fishermen can outfit their salmon purse seine boats with a herring seine for approximately $20,000-25,000 and electronic "fish finding gear" for $7,500-15,000. Receipts from herring fishing in 1974-75 helped supplement some southeastern Alaska purse seiners' incomes.

A study, conducted by the National Marine Fisheries Service in cooperation with the Alaska Department of Fish and Game, fishermen, and processors throughout the state, attempts to estimate the total

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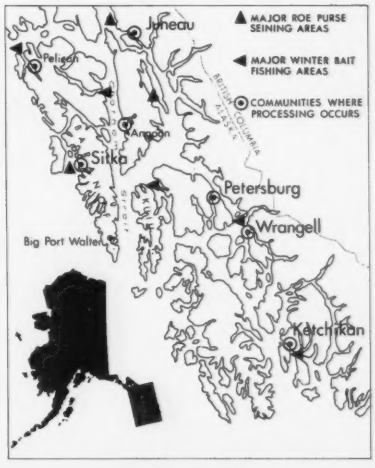

Grading roe, below and right.

Herring reduction plant, Big Port Walter, Alaska, with seiners both approaching and leaving the unloading dock. The entire operation was dependent on highly efficient Pelton wheel power. Circa 1930.

Purse seiners waiting for a Juneau area opening outside of Amalga Harbor.

contributions of the herring fishery to the economy of southeast Alaska. The study shows that, assuming a constant demand for herring products and a sustained availability of the resource, there is a tremendous growth potential for the herring industry in southeast Alaska.

Presently, about 14 percent of all southeast Alaska processing labor is devoted to herring production. The total employment during the peak of the herring roe fishery totals about 750 in processing and 80-100 individuals in fishing and tendering. The winter herring fishery employs about 50 and 60 in processing and fishing and tendering, respectively. The present industry contributes an estimated monetary benefit of over $2 million annually to the economy of southeastern Alaska.

Processors would support an immediate expansion in the spring herring roe fishery because this fishery has proven to be highly profitable and expansion requires little increase in facilities and investments.

Expansion in the meal and oil fishery would occur more slowly because of the large capital outlays that reduction machinery would require. This investment would not occur unless the meal market improves and a substantial increase in allowable her-

Graded roe worth thousands of dollars is stacked in baskets before further processing.

Whole herring bait packed in 50-pound boxes.

Final brining and salting process in export containers.

ring harvests was permitted. Most herring processing activity occurs in Petersburg, and this impact upon that community is considered here. There is, however, some herring fishing and processing in Ketchikan, Sitka, and Juneau. Herring fishery development would benefit these communities also.

FISHERY MANAGEMENT SITUATION

Management of herring stocks in southeastern Alaska has, for decades, been so steeped in complexity and controversy that the situation resists simple explanation. Salmon management disctrict boundaries are employed. Quotas filled in a single bay can result in closure of the district.

Acoustical techniques are being tested and used with moderate success for assessing biomass of herring stocks in certain southeastern Alaska bays. Herring quotas are limited to 10 percent of the biomass as measured by the acoustic work. Frequent disputes arise over both the 10 percent limitation and the reliability of still questionable acoustical assessing techniques.

In recent years, the herring quotas in Alaska have been quite restrictive because of pressure applied by some of the public constituencies who want herring used only for bait and for forage within the ecosystem.

HISTORY OF THE SOUTHEASTERN ALASKA HERRING FISHERY

Historically, herring has been a heavily utilized resource in Alaska. As early as 1916, several herring salteries in southeastern Alaska were supplying dry salted herring to the Oriental markets. Some herring were also processed for bait, oil, and fish meal.

The herring oil and meal reduction industry had its conception in the early 1920's. These plants produced pickled herring products and processed meal and oil. The peak of the herring reduction-oil industry occurred between 1926 and 1929 when 28 plants operating in southeastern Alaska were processing 140-166 million pounds of herring annually (Fig. 1). Most of the plants were located on Chatham Strait on both Kuiu and Baranof Islands. The most active season in this fishery was late summer and early fall when the oil and fat content of herring was the highest. The oil was sold to large soap manufacturers that used herring oil as a basic ingredient in their soap products. The meal was sold for fertilizer.

During the depression in the early 1930's,

Figure 1.—Comparative 50-year herring catch, 1924-74, for southeastern Alaska and all of Alaska, including events contributing to the growth and decline of the industry in southeastern Alaska.

the industry suffered severe setbacks. This continued into the war years until all herring purse seine fishing activity was stopped by the government. After the war, in 1946, four reduction plants began operation. That year was one of the most profitable for those existing plants in the history of the fishery because of the lack of competition from other producers. The price for oil then was 18-20 cents per pound. Also, by this time, all of the meal production was produced for the more profitable feed market. The meal market became more lucrative and in 1950 meal prices of $140-200 a ton were paid. Meal production then replaced oil in importance in production value because by 1950 soap companies began to manufacture detergents and oil prices dropped back to 4-5 cents per pound. The producers were able to protect themselves from fluctuating meal market conditions by hedging investments in the commodity future market.

By 1950, extreme pressures were placed upon the Territorial Board of Fish and Game to limit herring fishing. Most of this pressure came from the salmon troll fishing industry which claimed fishing was destroying the valuable forage necessary to sustain salmon stocks. One of the major fishing areas subjected to closure was Larch Bay, located south of Sitka. In some years 80 percent of southeastern Alaska's total production was caught there. This area was totally closed to herring purse seining by 1955. Also in 1955, Peru entered the world fish market by establishing an anchovy reduction fishery. By 1958, because of Peruvian production competition, meal prices in the United States were cut back to $80/ton. By 1959, over 60 percent of the world's fish meal was being produced by Peru, a fishery that was developed by the Food and Agriculture Orgnization of the United Nations and American industry investment. The agricultural sector concurrently increased its production and technology of soybean meal, furthering the production of competitive products.

By 1966 the southeastern Alaska herring reduction fishery industry was dead, from measures of pressure from opponents of the fishery and depressed market conditions. The bait fishery harvest has remained approximately the same, averaging 2,500 tons annually since 1910.

THE ALASKAN SAC ROE HERRING FISHERY

In 1963 the Japanese began to explore the possibilities of processing salmon roe in the northern and westward regions in Alaska. The Japanese, incidentally, discovered at this time that herring roe was available in the Kodiak Peninsula area in the late spring months. Consequently, in 1964, 23,000 pounds of roe were exported to Japan by a Kodiak Island producer. By 1971 the number of processors handling herring products had increased to 10. Their output of both herring roe and eggs on kelp totaled 334,000 pounds, valued at $1.5 million.

In 1973 more than 24 plants were processing herring in Alaska, 6 of them in southeastern Alaska. These firms produced herring products from a catch of 35 million pounds worth $6 million. Almost two-thirds of this value was comprised of roe and eggs on kelp products produced in central Alaska. Southeastern Alaska contributed 3 percent of the roe and eggs on kelp product value and 31 percent of the total product value of herring in Alaska.

Today, in terms of gross returns per season duration, the herring roe fishery is one of the most valuable in the world. That value and the total regional input of the herring roe and bait fishery industry to southeastern Alaska are discussed in MFR Paper 1239, "The Southeastern Alaska Herring Fishery," by Howard O. Ness.

MFR Paper 1240. From Marine Fisheries Review, *Vol. 39, No. 3, March 1977. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

MFR PAPER 1241

Observations on the Birth of a Southeastern Alaska Fishery

HOWARD O. NESS

The opening of the herring gill net fishery at Kah Shakes Bay (located at the entrance to Boca de Quadra) was one of anticipation. No one—neither the state and federal fisheries officials, seafood processors, nor the fishermen—was quite sure what to expect. The gill net opening was a departure from the traditional herring roe purse seine fishery that has occurred in southeastern Alaska since 1966.

Although a recently established Canadian skiff gill net fishery, while coexisting with purse seine efforts, has accounted for thousands of tons of high-value roe herring in past seasons, exclusive herring gill netting areas were not allowed in Alaska until the 1976 fall Board of Fisheries meeting in Juneau. At that meeting regulations were adopted providing for 10 fishing areas allotted exclusively to gill netting operations in southeast Alaska. The allowable quotas would be determined later, after stock assessment analyses by Alaska Department of Fish and Game officials divulged biomass estimates. Observers of Canadian gill netting have noted a number of advantages of harvesting with that type of gear. They are: 1) possible selectivity for bigger fish, and mature females in particular; 2) possible selectivity against small roe fish and spawn-outs; 3) slower rate of harvest (allowing more time for managerial decision-making); and 4) greater chance of selectivity for individual spawning stocks. Another advantage of the gill net fishery is the dispersion of benefits derived from the herring resource to the industry and the economy by allowing the participation of an additional low investment gear type.

The current regulations state that the minimum set gill net mesh size is 2⅛-inch stretch. No single net can be longer than 50 fathoms in length and the maximum aggregate length of the net is 200 fathoms per gear holder. The net is rigged with anchors and buoys and then shackled. The average fishing depth is about 6 fathoms. Some nets have spacers between the lead and cork line splice to allow the herring to drop freely from the top of the net into the bin. Traditionally gear is set and hauled from 18- to 30-foot skiffs but the current law does not regulate the vessel type or size.

The Kah Shakes Bay opening was closely monitored by Alaska Department of Fish and Game officials, processors, and fishermen.

I arrived at Ketchikan at 0845 Tuesday morning, 30 March, where I joined some processing representatives. I was to accompany their commissioned 51-foot tender, the *Rio Grande*, to the grounds. The vessel was built for trap tending in the 1930's and had a hold capacity of 23 net tons. The *Rio Grande* had a cash guarantee for this trip and would receive $50/ton for tendering. We left Ketchikan for Boca de Quadra at 1045 that same morning and arrived at the fishery site by approximately 1500 that afternoon.

The main fishery area was located in two sheltered areas, Bull Head Cove and Kah Shakes Cove, and many types of processing and tendering operations were represented. They ranged from fishermen's cooperatives, Alaska native tribal controlled companies, large and small cold storage firms, and purse seine boats that would tender catches back to the processors located at their home ports.

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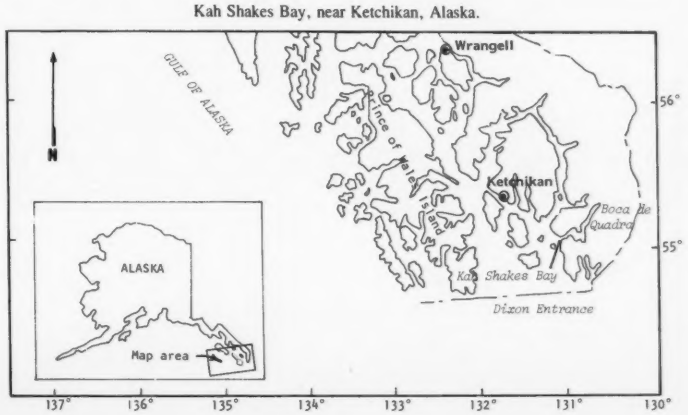
Kah Shakes Bay, near Ketchikan, Alaska.



Alaska Department of Fish and Game and fishing industry officials anxiously wait for herring roe yields to be determined by a Japanese technician.

A variety of tender vessels were present including converted trap tenders, power scows, tow boats, and purse seiners. Most of the participating fishing companies' tenders were already anchored up in Kah Shakes Bay; many had colorful names such as the *Howkan, Chichagof, Apache, Tomigan,* and *Sable*. The estimated total tendering capacity, including the purse seiners, was in excess of 1,000 tons. This was to accommodate a catch quota predicted to be not in excess of 500 tons.

By Wednesday noon there were approximately 40 gill net skiffs in the area. Many of these were purchased in Canada for a cost of $2,600. These, and six skiffs built in Petersburg, were constructed of aluminum and are from 28- to 29-feet long with an 8-foot wide bottom flaring to a 9½-foot beam at the gunnel. The Petersburg construction costs were approximately $2,200 per unit for materials only. Sorting bins were constructed by putting boards on the deck crosswise. Bins on the larger skiffs could accommodate almost 2 tons each for a total capacity of 6 tons.

The Alaska Department of Fish and Game (ADF&G) research vessel *Sundance* was the State of Alaska support vessel used in this fishery. This 72-foot converted albacore fishing boat was originally constructed in California. Dennis Blankenbeckler, a herring research biologist, conducted sonar survey stock assessments from the *Sundance*. The surveys were conducted just outside of Kah Shakes Bay. Interestingly enough, there were no historical herring assessment estimate data for Kah Shakes Bay.

At noon on Thursday, 1 April, it was announced during a meeting on the *Chichagof* that there was an estimated 3,000-4,000 tons of herring present and,

The first set of the season for these Ketchikan fishermen is hauled aboard the tender *Rio Grande* for testing.

Herring are brailed from a Canadian-built aluminum skiff.

unless conditions changed, 300 tons would be allowed as the maximum catch quota. Test fishing was permitted throughout the area to determine the maturity of the roe herring. The samples taken from test fishing indicated roe yields between 7.5 and 9 percent. The processors wanted to wait until roe yields for the total catch averaged an ideal 10 percent, because a loss in one percentage point in yield could mean tens of thousands of dollars in lost revenue to the industry.

Test fishing benefited the fishermen by allowing them to gain experience. Most of the fishermen present had never set a herring gill net before. There was even some discussion as to what side of the skiff the net should be set, pulled, and reset from; that is, the side having the shaking rack or the opposite side.

It was decided at the Thursday meeting by a majority vote of gear holders that the season would open Friday morning at 0800, and that ADF&G personnel would permit a 300-ton allowable catch. Many fishermen wanted the opening to occur Thursday evening; luckily for Ron Porter and Ole Haynes of Ketchikan, and New England Fish Company, it did not. Their crews were still constructing their NEFCO-financed plywood skiffs Thursday evening when the opening was announced.

Ole and Ron's purse seine vessels, each with two skiffs loaded crosswise on the afterdeck, appeared Friday morning, 1 hour after the opening. The paint was not yet dry or the leaks completely sealed. In fact, one skiff operator borrowed a hammer and nails from us and was continually patching as leaks appeared in the skiff on the grounds. The plywood skiffs cost a grand total of $200 each and, amazingly enough, held up quite well during the 12-hour period. One skiff unloaded over 7,000 pounds in a single delivery and it apparently had plenty of draft to accommodate even more herring, assuming the good weather conditions that were present then.

Prices were reported to be $250 per ton (including $50/ton for tendering) with a possibility for an adjustment after roe yield contents were sampled at the plants. Roe yields varied between 8 and 14 percent. Most of the loads that were delivered were sampled simply by dipping two buckets into a bin. Sex ratios were averaged at about 60/40, males to females, which was considered a high percentage of males for a gill net fishery.

Skiffs of every description including 14 sport fishing aluminum skiffs were used. There were bowpicker skiffs with two- and three-man crews that were apparently very inefficient because the net would bunch up after being pulled through the bow splines, and the herring were extremely difficult to shake loose from the webbing. Some skiffs supported a crew of five, and although it was apparent that these operations could pull nets effectively, some operators were fishing too much gear to be efficient. Other operations having a two-man complement were apparently undermanned.

Apparently some skiffs delivered nearly 18 tons for the day and earnings over $4,000 were reported. After all the data are compiled it will be interesting to compare the

Two fishermen in a Canadian-built skiff haul their set with the aid of a hydraulic net roller.

various skiff operations in terms of size of skiff, number of units of gear, crew on board, and income earned in that day's fishery.

At 1500 on 2 April it was announced that the fishery would close at 1600. That is, no more sets could be made after that time and fishermen were given a 4-hour period to retrieve all gear. Nets in the water would be allowed to "soak" until 2000 that night, at which time all of the gear would have to be out of the water.

John Valentine, Area Management Biologist for the ADF&G, reported that some fishermen were actually relieved at the closure announcement because of the extreme fatigue suffered pulling nets during the day.

At 2000 on Friday, 2 April, Alaska's first major herring gill net fishery closed, without major mishaps, and with an estimated harvest of 420 tons. Most of the fishermen were extremely satisfied with the fishery although there were a few dissenters who wanted a larger quota because of the apparent size of the spawning stocks indicated there.

MFR Paper 1241. From Marine Fisheries Review, *Vol. 39, No. 3, March 1977. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

MFR PAPER 1242

Seasonal Changes in Spatial Distribution and Activity of Two Species of Pacific Rockfishes, *Sebastes flavidus* and *S. ciliatus*, in Lynn Canal, Southeastern Alaska

H. RICHARD CARLSON and LOUIS BARR

ABSTRACT–Mixed aggregations of rockfishes near Auke Bay, Alaska, were observed by divers over all months of the year. The patterns of activity and distribution differed greatly between warmer months (May-October), when the fish were actively feeding and distributed above the substrate, and colder months (November-April), when the fish were partially or completely hidden between or beneath the substrate and were relatively sluggish and inactive. Selection probably favors this mode of behavior which renders the fish nearly inaccessible to predators when they would be most vulnerable and when food is scarce.

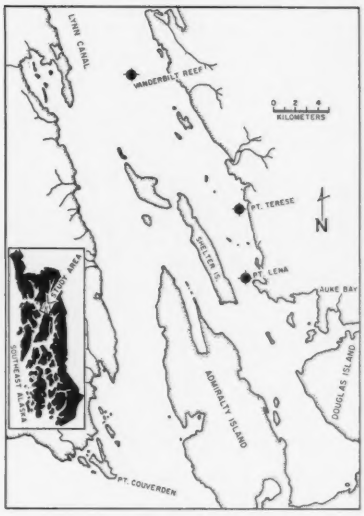


Figure 1.—Lower Lynn Canal, southeastern Alaska, showing three sites where rockfishes were observed by divers, 1965-75.

Seasonal changes in the spatial distribution and activity of Pacific rockfishes are sparsely documented. In a study of Puget Sound rockfish, *Sebastes emphaeus*, Moulton (1975) made 61 scuba diving observations of large populations over a 12-month period and noted that the number of fish sighted "declined dramatically" in the fall, and "most of the individuals seen by November were huddled in caves." Patten (1973) found that copper rockfish, *Sebastes caurinus*, in Puget Sound moved into a rock pile in the winter and during winter and spring, "only one or two of the largest fish were seen outside the rock pile and the others were well within the interstices." Miller and Geibel (1973) concluded that blue rockfish, *Sebastes mystinus*, in the Monterey Bay area spent the summer in kelp beds but overwintered in nearby but different habitat in order to avoid heavy swell action in the kelp beds caused by winter storms. Trawl catch records usually supply only general information on species occurrence, depth range, and month.

From 1965-75, divers from the Auke Bay Fisheries Laboratory of the Northwest and Alaska Fisheries Center observed in daylight mixed aggregations of rockfishes composed mostly of two species—*S. flavidus*, the yellowtail rockfish, and *S. ciliatus*, the dusky rockfish. The aggregations were located at depths of 13-28 m at the sites of sunken vessels at Point Lena and Vanderbilt Reef and at the base of a boulder-strewn slope at Point Terese (Fig. 1). The sites are in lower Lynn Canal, from 21 to 43 km north and west of Juneau, Alaska.

The rockfish aggregations we observed all appeared to have very restricted home ranges. In fact, yellowtail rockfish from Point Lena have been shown to have a keen ability to return to their home site even when displaced by as much as 22 km (Carlson and Haight, 1972).

The spatial distribution and activity of the rockfishes differed markedly between two periods of each year. From May through October, the rockfishes were generally active at all three sites (Table 1), and unless disturbed, they were distributed in the water column from one to several meters above (but apparently always retaining sight of) the substrate. The fishes hovered or milled slowly; if a current was present, they swam slowly into the current, maintaining their position in relation to the substrate. They were apparently feeding actively because they were vulnerable to capture on baited hooks. Also, they chased and bit small objects dislodged from the substrate by divers.

During November the aggregations disappeared from sight. At Point Terese the rockfishes moved back into crevices between boulders (Fig. 2) and for the remainder of the winter and early spring, we saw them only in such crevices—never above the substrate as in summer and early fall. When in the crevices during the November-April period, the fishes were inactive when undisturbed and sluggish in response to disturbance. Occasionally we could even touch them, something they would not allow at other times.

Although we were generally unable to find any rockfishes on the sunken vessel at Point Lena during the November-April period (no dives were made at the Vanderbilt Reef site in these months), we believe that the fishes at this site also seek cover in winter by going deeper into the wreckage both laterally and vertically beyond our

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normal diving excursions. Through the fall period, before disappearing from sight, the fishes at Point Lena move progressively deeper into the vessel. In the spring, when the fishes are first seen, they are still partly within the vessel (e.g., in funnels and under beams), further indicating that they are at that time gradually emerging after overwintering within the wreckage. Apparently the period of emergence is in April, and by May the fishes are again active and distributed in the water column above the substrate of the home range.

The seasonal change in distribution and activity of these rockfishes is probably a result of changing metabolic levels and is therefore related to periods of changing water temperature. Typical annual minimum and maximum water temperatures recorded at a depth of 20 m near the study sites at Auke Bay are 3°C in February and 9°C in August[1]. In October-November and April-May, when the distribution and activity of the fishes are changing, water temperatures average about 6°C and change relatively rapidly. The change in activity and distribution of the fishes between the warm and cold seasons is probably an essential survival mechanism that combines the conservation of energy during a period of apparent food scarcity with the inaccessibility of the fishes during the period when they would be least able to avoid predators, such as seals and sea lions, which are common in the area.

Figure 2.—Dusky rockfish, *Sebastes ciliatus*, at Point Terese, Lynn Canal, southeastern Alaska. The fish is in a position typical of the warmer months when they remain above the boulder-rubble substrate. During the colder months the fish retreat into crevices between the boulders.

Table 1.—Monthly spatial distribution and relative level of activity of the rockfishes *Sebastes flavidus* and *S. ciliatus* observed by divers on 81 separate diving days from 1965 to 1975 at three sites[1] in lower Lynn Canal, southeastern Alaska.

Month	Number of diving days in which rockfishes were: Present and active above the substrate	Present and inactive in contact with the substrate	Not seen	Total number of observations
January	—	1	—	1
February	—	1	7	8
March	—	1	4	5
April	—	1	1	2
May	4	1	—	5
June	16	—	—	16
July	11	—	—	11
August	11	—	—	11
September	4	—	—	4
October	7	—	—	7
November	—	4	2	6
December	—	2	3	5
Total	53	11	17	81

[1]The sites are Point Lena, Point Terese, and Vanderbilt Reef (Fig. 1).

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MFR Paper 1242. From Marine Fisheries Review, *Vol. 39, No. 3, March 1977. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

NOAA Funds Major Alaskan Marine Studies

Nearly a quarter of a million dollars in supplemental contract funds have been awarded to Western Washington State College (WWSC) in Bellingham by the National Oceanic and Atmospheric Administration (NOAA). The $244,473 will be used to continue research on marine plant and animal life along Alaska's northern shoreline. The college had earlier received $98,856 from NOAA, a Commerce Department agency.

BEAUFORT AND CHUKCHI SEA HABITATS STUDIED

An overall objective of the research is to characterize the habitats and ecological relationships of predominant plant and animal species along the shorelines of the Beaufort and Chukchi seas. Continuing work begun in the summer of 1975, WWSC researchers will sample key sites from Point Barrow east to the Canadian border and southwest to Kotzebue and Cape Prince of Wales.

Results of the research will include distribution maps of Beaufort and Chukchi Sea habitat types, and quantitative estimates of predominant marine populations and their nutritional and other ecological requirements. Data from the multi-year study will help scientists estimate the potential risks incurred to resident and migratory marine life from outer continental shelf oil and gas exploration and development.

RESEARCH CONTINUED ON OIL AND MARINE SPECIES

Another supplemental NOAA contract totaling $247,172 has been awarded to Oregon State University (OSU) at Corvallis to continue research on the effects of oil spills on fish, shellfish, marine birds, and seafloor organisms in Alaskan Waters. Oregon State University had previously received $300,734 from NOAA.

The OSU scientists will continue research on the acute and chronic effects of crude oil and other petroleum-associated chemicals on Dungeness crabs, fish-eating birds, shellfish, and various microorganisms in the Gulf of Alaska and the Beaufort Sea. Studying the effects of potential oil spills on Dungeness crab larvae has particular economic significance for Alaska, which has harvested from 10 to 40 percent of the total catch from the Pacific coast in recent years.

The OSU and WWSC contracts are part of a major marine environmental study conducted by the Commerce Department agency's Environmental Research Laboratories (ERL) for the Interior Department's Bureau of Land Management Outer Continental Shelf Environmental Assessment Program. The studies seek to determine the probable ecological impacts of oil exploration and development activities on Alaska's outer continental shelf.

BASELINE ECOLOGY STUDIES

Nearly $1,000,000 in supplemental NOAA contract funds have also been awarded to the Alaska Department of Fish and Game. The $964,063 will be used to continue research on baseline ecological studies of migratory birds, fish and shellfish, seals, and sea otters in Alaskan coastal regions. Like the OSU and WWSC contracts, this too is part of ERL's major environmental sutdy for the Interior Department's Bureau of Land Management.

A portion of the contract funds will be used to make further studies of spawning grounds used by the Pacific herring and five species of smelt in the Bering Sea. Because Alaska coastal residents have depended upon the Pacific herring as a vital part of their subsistence catch for thousands of years, the Alaska researchers will make additional aerial and "ground truth" beach surveys for their baseline studies of the fisheries before major petroleum development activities occur. Alaska Department of Fish and Game biologists will also continue their research to define the Pacific razor clam populations in the Gulf of Alaska.

The Gulf of Alaska and the Bering, Beaufort, and Chukchi seas are all included in the state agency's studies of the various species of seals and sea otters which inhabit these regions. The researchers will also continue their compilation of maps identifying all major bird habitats along Alaska's coastline.

By correlating important life history data of fish occupying the nearshore areas of the Beaufort Sea with knowledge of habitat needs, the biologists hope to obtain baseline information that can be used to direct the activities of people and industry in proposed petroleum lease areas there. The Alaska Department of Fish and Game had previously received $1,182,427 for work related to NOAA's outer continental shelf environmental program.

EFFECTS OF OIL EXPLORATION

Further supplemental ERL contract funds totaling $1,168,613 have been awarded to the University of Alaska at Fairbanks by NOAA to continue research on the potential effects of offshore petroleum exploration and development along Alaska's coastline.

Among the research projects to be undertaken by the University of Alaska's Arctic Environmental Information and Data Center is a study and analysis of climate conditions along the entire coastline of Alaska. Results of the study will provide broad guidelines for site selection of onshore petroleum facilities and pinpoint where more detailed evaluations of climate are needed for potential site construction. To date, the University Center has completed a series of 32 annotated maps that depict the natural resource and environmental conditions for the region between the Bering Strait and Icy Cape in the Gulf of Alaska near the Yukon Territory-Alaska border.

The University's Institute of Marine Science will continue to expand its natural hydrocarbon measurements program, including the collection of floating tar samples, begun in the Gulf of Alaska during the past year. They also will study the mechanisms which influence seasonal variations of currents and large water masses in the Gulf.

Marine life is also a target of the University's research. The Institute will determine the environmental impact from oil-related industrial activity on select marine "indicator" organisms by establishing baseline levels of trace heavy metals now present in the organisms.

The Institute of Arctic Biology will make special studies of birds in Norton Sound and Kotzebue Sound. Baseline information is

needed to evaluate the impact of increased human activity associated with petroleum development on birds and their habitats.

A portion of the supplemental funds will be used by the University's Geophysical Institute to produce three sets of maps, displaying information necessary for an environmental assessment of the coasts of the Bering and Beaufort seas. When work is completed, the researchers will have produced a total of 72 maps for the Bering Sea and 30 maps for the Beaufort Sea, indicating the stability of the shoreline, the various coastal landforms, and the distribution of beach materials such as sand and gravel.

The contracts include $692,482 to the Geophysical Institute and $476,131 to other departments at the University of Alaska. Under two separate contracts, NOAA had previously awarded the University of Alaska $4,796,028.

SHELLFISH BIOECONOMICS

A $99,995 contract has also been awarded by NOAA's National Marine Fisheries Service to the Alaska Commercial Fisheries Entry Commission for bioeconomic research of Alaskan shellfish fisheries.

One of eight similar contracts awarded for bioeconomic studies in various geographical areas, this provides for research on domestic harvesting capacity, diversification capabilities and desires of fishermen, and the extent to which overcapitalization has occurred in Alaskan shellfisheries. Study activities call for the establishment of shellfish research groups in five key geographical areas: Petersburg, Cordova, Homer, Kodiak, Alaska; and Seattle, Wash. The information obtained from the study is expected to prove helpful in the development of fishery management plans by the North Pacific Fishery Management Council, one of eight recently formed.

Established by the Fishery Conservation and Management Act of 1976, the councils have responsibility over fisheries within the 200-mile fishery conservation zone adjacent to the states within their regions. Under this Act, the councils are charged with the development of fishery management plans consistent with certain national standards which require consideration of social and economic aspects of fisheries management. The bioeconomic studies are expected to prove useful to the councils by providing information on these.

The Alaska Commercial Fisheries Entry Commission, working in close cooperation with the Alaska Department of Fish and Game, has been responsible for monitoring the harvest of Alaskan commercial fishery resources.

Marine Mammal Guide Published by NOAA

A field guide to help identify whales, dolphins, and porpoises in the western North Atlantic has been published by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service.

"Whales, Dolphins, and Porpoises of the Western North Atlantic - A Guide to Their Identification" also includes those animals found in the Caribbean Sea, Gulf of Mexico, and the eastern coastal waters of the United States and Canada.

While the 176-page volume is intended as an aid to identifying living animals at sea, it also is expected to assist in the reporting of stranded specimens, a major source of material for museums. Appendices describe how and to whom data on live or dead whales, dolphins, and porpoises should be reported.

Regardless of their scientific relationships, all the specimens covered in the main text of the Commerce Department agency's guide are divided into small, medium, and large categories.

Photographs of the animals in their natural environment, supplemented by drawings and descriptions or tables distinguishing the most similar species, form the core of the guide.

Following the summary accounts of the species are five appendices covering tags and markings; how to record and report observations at sea; strandings and handling; forms and instructions for measurements; and institutions for information, and for reporting strandings.

Also included is a bibliography of useful references on cetaceans in general and cetaceans of this region in particular, as well as a directory of species explanations.

Funds for the preparation of the guide were provided by a NOAA grant to Stephen Leatherwood of the Naval Undersea Center, San Diego. Co-authors of the guide are David K. Caldwell of the University of Florida, and Howard E. Winn, of the University of Rhode Island, with special assistance from William E. Schevill of the Woods Hole Oceanographic Institute, and Melba C. Caldwell, also associated with the University of Florida.

This photo of a fast-swimming blue whale is one of many illustrations from the new NOAA publication "Whales, Dolphins, and Porpoises of the Western North Atlantic—A Guide to Their Identification."

The NOAA Technical Report NMFS Circular 396, Catalog #C-55.13, is for sale at $2.45 each by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

NOAA Weather Radio Aids Boaters and Fishermen

America's fastest-growing radio network, NOAA Weather Radio, gives the Commerce Department's National Weather Service a potent, fast-moving technique for spreading storm and flood warnings. Its potential for saving lives is considered high.

NOAA Weather Radio began in a small way in the mid-1960's. Then, it was a new National Oceanic and Atmospheric Administration service to boaters and fishermen. Today, it has more than 100 stations and by 1980 it is expected to have more than 300 outlets ready to serve 90 percent of the country's population.

When a natural disaster threatens, forecasters move quickly to broadcast warnings, taped or live, accompanied by vital safety information with immediate utility. Lest the spoken word go unnoticed, forecasters can trigger "warning alarm" receivers to emit a high-pitched tone of unmistakable urgency. In some receivers, the tones activate a siren which alerts the listener to turn up the volume; in others, they automatically increase the decibels so the weather message is certain to be heard. This feature is especially useful in schools, hospitals, and other institutions.

NOAA Weather Radio broadcasts are retransmitted over cable television in some locations; some cable operators alert subscribers to urgent messages with beepers loud enough to waken sleepers. Others offer a voice override enabling local public safety officials to blank out the cable TV audio and issue weather warnings—a valuable time-saver when seconds count.

In January 1975, NOAA Weather Radio was designated by the White House as the sole Government-operated radio system to provide warnings directly into homes, not only for natural disasters but for nuclear attack.

In less dramatic times, however, the "other network" just goes on about the weather, 24 hours a day, 7 days a week. Taped in Weather Service offices, the transmissions feature the latest observations and forecasts and a variety of specialized weather information depending upon the locality. Messages average 4 to 6 minutes, are repeated without pause, and are revised as required, ordinarily every 2 or 3 hours to provide the listener with the very latest information.

The broadcasts are heard in most locations in a radius of about 40 miles, but effective range varies with the terrain and the receiver.

Broadcasts contain a wide variety of specialized information. Along the coasts and the Great Lakes, the concentration is on information for boaters, fishermen, and others whose work or play take them to the water. Where the potential for flooding is strong and waterway navigation is important, river forecasts are emphasized.

In farm country, special information is issued for orchardists, ranchers, and others involved in agricultural operations.

To hear this unique service, one must obtain a special high-band receiver capable of picking up 162.40, 162.55, or 162.475 megahertz. They cost from $10 to well over $100, and performance varies widely. Some have automatic warning capability; others do not. Also on the market are numerous multi-purpose radios with the "weather band."

Quality of reception varies with the terrain and other factors. NOAA recommends that prospective buyers make final acceptance of a receiver conditional upon a test in the setting where it will be used, and that institutional users purchase high-quality commercial receivers.

As of last summer, NOAA Weather Radio operating locations were:

Alabama—Huntsville and Mobile; Alaska—Anchorage and Seward; Arizona—Phoenix; California—Coachella, Cresent City, Eureka, Los Angeles, Monterey, Point Arena, Sacramento, San Diego, San Francisco, San Luis Obispo, Santa Barbara; Colorado—Denver; Connecticut—New London; Florida—Daytona Beach, Jacksonville, Key West, Miami, Panama City, Pensacola, Tallahassee, Tampa, West Palm Beach; Georgia—Atlanta, Savannah; Hawaii—Hilo, Honolulu, Kokee, Mt. Haleakala.

Illinois—Chicago; Indiana—Evansville, Indianapolis; Iowa—Des Moines; Kansas—Wichita; Kentucky—Ashland, Bowling Green, Covington, Hazard, Lexington, Louisville, Mayfield, Somerset; Louisiana—Baton Rouge, Lake Charles, Morgan City, New Orleans; Maine—Ellsworth, Portland; Maryland—Baltimore, Salisbury; Massachusetts—Boston, Hyannis; Michigan—Alpena, Clio, Detroit, Grand Rapids, Marquette, Sault Sainte Marie, Traverse City; Minnesota—Duluth, Minneapolis; Mississippi—Gulfport, Jackson; Missouri—Kansas City, St. Joseph, St. Louis.

New Jersey—Atlantic City; New Mexico—Albuquerque; New York—Buffalo, New York City, Rochester; North Carolina—Cape Hatteras, New Bern, Wilmington; Ohio—Akron, Cleveland, Columbus, Sandusky; Oklahoma—Tulsa; Oregon—Astoria, Coos Bay, Eugene, Newport, Portland; Pennsylvania—Erie, Philadelphia, Pittsburgh; South Carolina—Charleston, Myrtle Beach; Tennessee—Nashville; Texas—Brownsville, Corpus Christi, Dallas, Fort Worth, Galveston, Houston, Pharr; Utah—Salt Lake City; Vermont—Burlington; Virginia—Manassas, Norfolk; Washington—Neah Bay, Seattle, Yakima; Wisconsin—Green Bay, Milwaukee.

Office of University Affairs Opened by NOAA

The National Oceanic and Atmospheric Administration (NOAA) has established an Office of University Affairs, Robert M. White, Administrator, announced in mid-December. The new office will be headed by Robert B. Abel, Director of the National Sea Grant Program. Abel will be succeeded in the Sea Grant post by Ned A. Ostenso, Deputy Director and Senior Oceanographer of the Ocean Science and Technology Division, Office of Naval Research.

The reorganization will bring new strength to NOAA, a major agency of the Department of Commerce, according to White. "The need for a University Affairs Office has been evolving steadily," he said. "Dr. Abel, whose distinguished career in marine science has been built upon collaboration with our major educational institutions, is an ideal choice as its Director. We are fortunate that with the Sea Grant program on a firm foundation, to a great degree through his efforts, he has accepted the challenge of this new post.

"We are equally fortunate that Dr. Ostenso has agreed to assume direction of the National Sea Grant Program, one of the most important marine efforts in the nation."

The Sea Grant program is designed to encourage and accelerate marine development through a system of grants. It operates at a level of $27 million annually.

Commenting on the need for a University Relations Office, which will report directly to the Administrator, White said: "The successful discharge of NOAA's responsibility is dependent upon a broad range of interactions between NOAA and the university community. Traditionally, NOAA has depended upon universities to carry out certain research in support of its activities under grant or contract. The largest of these university efforts has been our Sea Grant program. However, NOAA's interactions with universities extend far beyond those involved in the Sea Grant program, and they are becoming increasingly diverse. Our support of research and development at universities has grown substantially over the past five years, to the point where today we expend over 33 million dollars annually for research and development in oceanic, atmospheric, fisheries, and earth sciences, as well as in diverse fields of public policy.

"Our interactions with the universities do not stop with direct financial support," White continued. "Our long standing policy of collocating our research laboratories on university campuses has enabled us to initiate many new forms of collaborative effort with universities. Many NOAA scientists hold professorships in the universities at which the laboratories are located. In turn our laboratories have become foci for facilitating training of students.

"We have many educational and training programs which bring us into close contact with universities. We are totally dependent upon universities for the education and training of the professionals we recruit. Because we are so dependent upon universities for the output of trained personnel for our organization, we have an obligation to see to it that these institutions are capable of continuing such training to provide the personnel that we will need in future years.

"A vital channel for our relationships with the academic world is the National Academies of Sciences and Engineering," White said. "We participate in or interact with many committees in the Academy structure. Our interactions have become so numerous that it is necessary to systemize the way in which we conduct our affairs with the Academies.

"This diversity of relationships with the university community calls for a means whereby NOAA can effectively deal with them. We need an organizational focus to coordinate our activities where this is necessary, and to foster and stimulate further interest within our own organization in working closely with the university community. In addition," he concluded, "it has become important that we improve the means whereby universities can interact with NOAA in a more systematic fashion."

NOAA Scientist Models Great Lakes Phosphorus

Efforts to halt the rampant algae growth caused by phosphorus pollution in the Great Lakes may be effective by 1985, but western Lake Erie will never be as "clean" as the other lakes.

These are among the predictions of a mathematical model developed at the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory. The model, still being refined by Steven Chapra of the Ann Arbor, Mich., laboratory (one of NOAA's Environmental Research Laboratories), is a set of equations describing the behavior of phosphorus in the Great Lakes which the scientist believes can be used to aid in planning pollution abatement programs.

Increases in the nutrient phosphorus—largely from human sources—have accelerated the natural process of eutrophication (biological productivity) in the lakes. If unchecked, this process could cause a lake to literally grow itself to death, becoming clogged with algae until decomposition of organic matter removed oxygen from the water depths and fish and other fauna could not survive.

Efforts at preserving the lakes have concentrated on limiting the amount of phosphorus entering them. Knowledge of the sources and sinks of the nutrient in the lakes would make the task easier, but the size of the lake system makes direct measurement costly and difficult. A mathematical model that simulates phosphorus budgets—a balance of the processes that add or remove phosphorus from the lake system—would fill the need.

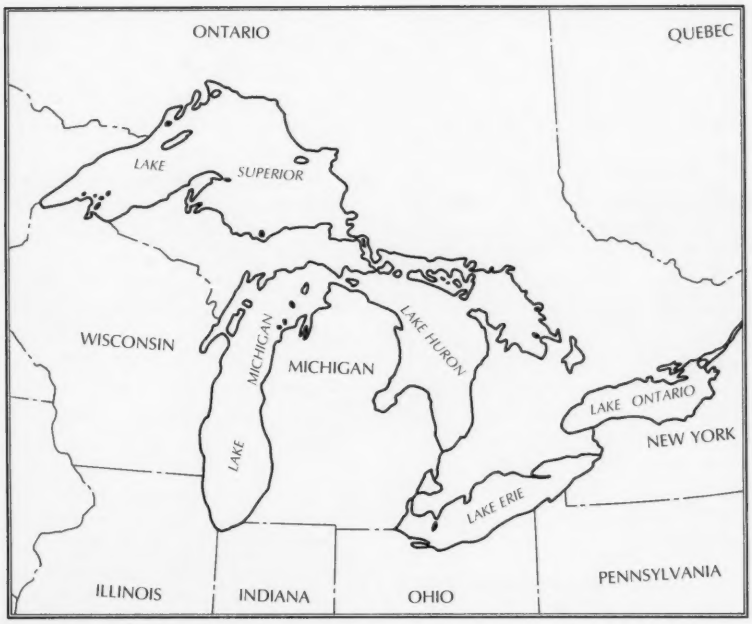
Chapra's model takes into account three basic sources of phosphorus: domestic, land runoff, and atmospheric. Domestic sources, he explains, include the sewered wastewater from residences, businesses, and institutions. Human waste and detergents are by far the biggest contributors of phosphorus in this category.

The amount of phosphorus that washes into the lakes from the land depends upon how the land is used—whether it is agricultural, urban, or forested land—and also on such factors as topography, precipitation, soil characteristics, vegetation, animal population, and manipulative practices such as fertilizing. Finally, dust, rainfall, and snow also drop phosphorus into the lakes. On the other side of the scale, a sizeable fraction of incoming phosphorus is removed by incorporation into lake sediments.

To test the model, the Commerce Department scientist used it to simulate phosphorus inputs and concentrations from the year 1800 to 1970 and compared the results with actual measurements. Chapra fed in the probable conditions of the lakes in 1800, when the main sources of phosphorus were the atmosphere and runoff from forested land, and the model simulated the changes that took place as the population around the lakes grew and the forests gave way to wharves, farms, and cities. In the end, the 1970 phosphorus levels predicted by the model agreed well with measured values.

The simulation also provided some new insights. It suggested, for example, that there is a physical limitation to water-quality improvement in the Great Lakes. Western Lake Erie, a small basin that collects water—and phosphorus—from a large area of land, has a calculated natural phosphorus concentration 50 percent higher than the next highest lake. "This suggests that total removal of cultural wastes would never bring western Erie to the levels possible in the other lakes," said Chapra.

Over the past 170 years, the calculations showed, the lakes have suffered two major periods of increased phosphorus loading. In the latter part of the 19th Century, the forested land was cleared for agriculture, causing phosphorus increases in all the lake basins. Then, after about 1945, population growth, a resulting increase in sewage, and the introduction of phosphate detergents



A refined mathematical model of phosphorus behavior in the Great Lakes may aid pollution abatement programs.

made a strong impact, particularly on lakes Erie, Ontario, and Michigan. Huron and Superior were relatively less affected by the population change, hence treatment of domestic point sources of pollution would have little effect on water quality in those lakes, Chapra notes.

The experiment also demonstrated that Lake Ontario's health is significantly affected by the health of the lake upstream, Erie, and the scientist concludes that a coordinated program of waste abatement would be necessary for those two lakes.

Chapra also used the model to try to predict the success of phosphorus abatement programs that concentrate initially on reducing domestic sources. In general, the goal of these programs is 1 mg of phosphorus in each liter of effluent by 1980.

It is estimated that every day about 150 gallons of effluent are poured into the lakes for each inhabitant of the basin. If abatement programs go according to plan, by 1980 the inflow of phosphorus into the lakes would be 0.46 pounds (209 grams) per capita per year. Under such conditions, Chapra found, all the lakes would show marked improvement by 1985. However, Lake Erie—particularly the western basin—would require additional treatment to reach acceptable levels of productivity.

Chapra cautions that this prediction is based on the assumption that phosphorus loss to sediments is a one-way process. For most of the lakes, it is, but once again Erie is the exception. In Erie, phosphorus levels in sediments are already so high that reduction of the amount of phosphorus in the water might cause some of that trapped in sediments to leak back into the water. In addition, the western and central basins of Lake Erie are so shallow that storms can stir up sediment and mix phosphorus back into the water.

Chapra points out that his model is designed to aid management decisions, and that the computer program is structured so that political or geographic distinctions can be made. "Thus it is relatively easy to develop scenarios of future conditions which ask questions such as 'What would happen if the State of Michigan outlawed detergents, while all other parts of the region did not?'" he said.

The NOAA researcher is planning some refinements of the model—such as better handling of diffuse sources and the addition of sediment-water interactions—that should enhance its usefulness. "When such modifications are made, the approach will offer a comprehensive and relatively inexpensive package for investigating man's impact on the future water quality of the Great Lakes," Chapra said.

Fishing Experiments Told For NW Hawaiian Islands

The Honolulu-based research ship *Townsend Cromwell* returned to port in late November 1976 after 2 months of fishery and oceanographic surveys at selected sites along the Northwestern Hawaiian Islands. Experimental bottom trawling, fish and lobster trapping, and handlining were conducted by personnel from the Honolulu Laboratory of the National Marine Fisheries Service (NMFS), according to Laboratory Director Richard S. Shomura. The *Cromwell* is one of a fleet of 25 research vessels belonging to the National Oceanic and Atmospheric Administration.

Included in the cruise was a survey of Hancock Seamount, a pinnacle rising 1,600 fathoms from the floor of the ocean just 200 miles northwest of Midway Island. There, foreign fishing vessels have been reported to harvest thousands of tons of pelagic armorhead. Chief scientist Thomas S. Hida also reported the trapping, tagging, and release of 596 spiny lobsters for population studies in waters surrounding Necker Island.

Several hundred pounds of "red tail" opelu were caught at depths of about 200 fathoms off Necker and Laysan islands. Until last year this species of scad was not recorded from the Hawaiian Archipelago. Participating in the cruise were bottom trawling gear experts from the NMFS Northwest and Alaska Fisheries Center in Seattle. Marine mammal observers from the University of Hawaii were also included in the scientific complement.

This cruise of the *Townsend Cromwell* was one of the first in a 5-year intensive survey and assessment of the inshore and inner slope resources of the little known area to the north and west of the main Hawaiian Islands. Cooperating in the undertaking are NMFS, the U.S. Fish and Wildlife Service, and the Department of Land and Natural Resources of the State of Hawaii.

Zairians Fish Lake Tanganyika From Kalemie

The city of Kalemie, formerly Albertville, is the principal commercial and industrial center in the northern part of Shaba Province (formerly Katanga), Zaire. Kalemie is the largest Zairian port on Lake Tanganyika and the terminal of a railroad, which is probably the community's single most important employer. The fishing industry in Kalemie, once exclusively in the hands of Greeks, is now largely controlled by Zairians, although Greek management influences have recently been increasing. The fishing boats are run largely by Greeks. The various commercial establishments (which were also formerly in the hands of the Greeks) now seem to be largely controlled by Arabs. Arabs were allowed to remain in business after other foreign companies were turned over to Zairians, because of the petroleum shipments of Middle Eastern countries.

In 1956, the city of 25,000 had a European population of 967. At present, there are about 80,000 people in Kalemie of whom no more than 150 come from Europe. Although an occasional shop appears abandoned and some others are short on supplies, particularly drugs and hardware, most are well stocked. There is electricity, running water, a clean hotel, a movie theater, and a few restaurants. The town presents a fairly prosperous air, especially in recent weeks when an expected visit by President Mobutu (he never came) brought forth a fresh coat of whitewash on many buildings.

HISTORICAL BACKGROUND

Commercial fishing, as it is presently practiced, dates back to the middle 1950's when the first Greek fishermen arrived from Bujumbura in Burundi and found fishing conditions good. By 1972, there were 22 locally constructed steel fishing boats from 35 to 50 feet long, owned and operated almost solely by Greeks, mostly from the islands of Rhodes and Cyprus. In 1973-74, the industry was Zairianized along with other industries. Zairians from Kinshasa and Kalemie obtained most of the boats. One Greek-American was able to maintain ownership of his boat because he was an American citizen. He remained the only foreign fishing boat owner. Most Greeks, which had also owned the majority of stores in Kalemie, departed during 1975. By 1976, there remained no more than 20-25 Greek residents in Kalemie.

Some Greeks fought to reacquire their fishing assets with success. One older Greek Cypriot argued that his homeland was now occupied by the Turks and that he had no place to go after his Zairian assets were taken from him. His fishing boat was returned to him, but the return of his small retail store was blocked by a local official. Another Greek had papers prepared which showed how much his assets had been run down by the new Zairian owner in a short period of time. At present, only four Greeks own fishing boats, but they all have Zairian partners.

SPECIES, GROUNDS, AND SEASONS

The Kalemie fishery is primarily directed at a herring species called dagaa by local fishermen. The fish may be found near the surface only at night. During the day they remain at a depth of more than 120 meters. These daily vertical migrations are conditioned by the movements of the plankton on which they feed. Plankton rise during the night, but move into the dark depths of the lake as soon as sunlight strikes the water. All dagaa fishing is done on moonless nights, when the schools feed not more than 10 meters below the surface and can be easily scooped up. Fishing is best from August to May, particularly during the rainy season, when bigger fish can be found in shallower waters. During June and July, the prevailing winds create surface conditions which are too rough for the boats.

Figure 1.—Map of Lake Tanganyika and surrounding countries.

VESSELS AND METHODS

The dagaa fishery is conducted by motherships which travel 2-4 hours from shore every evening, pulling behind them a string of four or five smaller craft. Out of 22 boats, only about 16-17 operate regularly. All but one of these smaller boats are equipped with double Coleman-type lanterns extending over the water on the back side. On the fishing grounds, these smaller boats are anchored for a few hours with their lights shining to attract the fish. The two motherships then surround the smaller lighted boats, one at a time, with a net. After the net is pursed, each small lighted boat leaves the circle, and the whole net is pulled in. The operation around each of the lighted boats takes about an hour.

MARKETING

Pulling its string of smaller craft and loaded with the nightly catch, the motherships attempt to reach the river channel, where they are docked, as near to daybreak as possible. Fish prices are best for the boats which reach the port first before the size of the total night's catch is known. Each boat owner deals with the same middleman every day. The middleman, always a Zairian, buys 20-kg boxloads of fresh unchilled fish at prices currently starting at about 7 or 8 Zaires (US$8.05 to $9.20)[1] per box in the earliest hours of the morning. The middleman sells the fish to local stall owners for whatever the market will bear. Almost all of the fish is sold locally because of inadequate refrigeration and transportation facilities. The national food chain (SGA), sometimes purchases fish for delivery to the capital in Kinshasa. The daily catch can vary from 20 boxes to 250 boxes per boat with about 50 being the average during June and July.

CREW

Each ship has a captain and about 20-25 crew members. The captain earns about 200 Zaires (US$230) per month, the crew gets 1 Zaire (US$1.15) per working day. In addition, each crew member seems to have his own basket or other means to stash away a few fish for his family's consumption or private sale. About five boxes are generally "lost" out of a catch of 50 boxes. The owners are stricter when the catch is small, but always try to keep stealing limited because the crew members will not show up for several days of work if they made a good profit from pilfered fish on any one day. Stealing is tolerated because it supplements wages and firing crew members is difficult. The Zairian crews may not like the boat owners, particularly the Greeks, but they respect them for providing a steady livelihood. Crew members of at least one boat joined in petitioning the local officials to return a boat from its present Zairian "acquereur" to its former Greek owner.

PROFITS

The Greeks remain active in the fishing business because of the high profits. The profits are less now, but still good, although there is some talk of getting out of the fishing industry. The price of fish is about four times what it was before Zairianization, but costs are up even higher. One Greek said he did not like to undertake an investment unless there is a good chance of a 100 percent profit in 1 year. In addition to wages, the principal expenses are for petroleum, spare parts, and payments to officials. Each evening's fishing consumes one barrel of petroleum. While the petroleum distributor, PetroZaire, is supposed to make available sufficient stocks for local industries, the records are often doctored and the petroleum only available on the black market. Payments to various intermediaries double the cost of petroleum. Spare parts are not locally available, nor is it easy to obtain a foreign exchange allocation for purchases abroad.

The Greek fishing boat operators are quick to bemoan the total situation, often talking of getting out of the business and out of the country. All live rather simple lives in Kalemie, but most are able to support families abroad and take long vacations out of the country. For most, the profits seem to remain adequate. The older ones stay because it is their whole life, the younger ones because they see nothing else more profitable on the horizon. The Zairian workers know the Greeks will provide steady work which was not the case when their own countrymen ran the fishing industry. The military and political figures appreciate the financial rewards the Greeks bring them. The relationship is symbiotic and mutually beneficial to the individuals, but more parasitical than beneficial to the development of a healthy economy. (Source: U.S. Consulate, Lubumbashi.)

Second in size only to Lake Victoria to the northeast, Lake Tanganyika is one of Zaire and Tanzania's major fishing grounds. Fishing depends almost entirely on two small fresh-water clupeids, known locally as dagaa. Many small fishing communities are located along the lakeshore where land is available for rice and other subsistence crops. Such areas exist mainly where rivers flow into the lake.

Lake Tanganyika contains over 200 known species, many peculiar to it. The principal commercial species taken are listed in Table 1.

Table 1.—Fish species found in Lake Tanganyika.

Family and species	English	Swahili
Clupeidae (herrings)		
Stolothrissa tanganicae	Sardines or whitebait	Dagaa
Limnothrissa miodon	Whitebait	Dagaa
Cichlidae		
Boulengerochromis microlepis	Yellowbelly	Nguhe
Tilapia melanopleura	Tilapia	NA
Tilapia tanganicae	Tilapia	NA
Centropomidae (robalos)		
Lates microlepis	Nile perch	Pamba
Lates augustifrons	Nile perch	Sangala
Lates mariae	Nile perch	Nonzi
Luciolates minor	Perch	Mgebuka
Characidae		
Hydrocyon lineatus	Tiger fish	Kibebe
Alestes macrophthalmus	NA	Manzi

Clupeids are the most important family in the commercial fishery. Two species, *Stolothrissa tanganicae* and *Limnothrissa miodon*, are the staple product of native fisheries. They also provide food for the Nile perch and other predators found in the lake. *Stolothrissa* reaches 8 cm and *Limnothrissa* 15 cm in length.

Cichlids are also abundant but more varied; as long ago as 1901, Boulenger described more than 60 species belonging to 21 genera. Cichlids are the most prized food fish, especially the species *Boulengerochromis microlepis*, which weighs up to 3 kg, and *Tilapia tanganicae*, the most common cichlid in the lake. The deep lake waters are known to be well endowed with cichlids and other edible fish. These waters, however, have no clupeids or other algae-eating fish since only a shallow layer of surface waters is capable of producing algae.

[1]The conversion rate was calculated at the official rate of 1 Zaire = US$1.15, 30 September 1976. Zaires can be bought for much less on the free market.

Other food fish which are much larger than the clupeids or cichlids belong to the family Centropomidae. Among the centropomid fishes, the predatory Nile perch has three species peculiar to Lake Tanganyika. They grow as large as 100 pounds, but the flesh of specimens of this size is coarse.

ROK Longliner Has King Crab, Salmon, Halibut; Owner Is Fined $325,000

National Marine Fisheries Service Special Agent Dean L. Owren observed the Republic of Korea (ROK) longline vessel *Dong Won No. 707* haul back a king crab on its longline gear while fishing off Baranof Island, Alaska, on 1 August 1976. The NMFS Special Agent and a boarding party from the U.S. Coast Guard Cutter *Jarvis* boarded and inspected the ROK vessel in position lat. 56°30'N, long. 135°48'W.

They found 1 golden king crab varnished and prepared for mounting; 15 fresh king crab legs or leg segments; 2 fresh king crab claws; 10 frozen king crab legs; 1 frozen salmon; and 1 frozen halibut. The *Dong Won No. 707* was seized on suspicion of violating U.S. laws regarding the retention of Continental Shelf Fishery Resources (CSFR) and was escorted to Sitka, Alaska.

The *Dong Won No. 707* (620 GRT) is a 54-meter longline vessel built in 1966 and owned by the Dong Won Ice Company, Pusan, ROK. It fished primarily black cod, *Anoplopoma fimbria*, using longlines and a few pots. Its catches were headed, gutted, and quick frozen on board. This is the first case involving retention of CSFR by a longline vessel off Alaska. Longline gear is designed to take free-swimming species of finfish, not crustaceans which dwell on the bottom.

On 12 October 1976, the owner of the *Dong Won No. 707* agreed to pay a $325,000 civil penalty for violating U.S. law. Criminal charges against the master of the ROK vessel were dropped. The *Dong Won No. 707* departed U.S. waters on 13 October.

According to the NMFS Office of International Fisheries, the *Dong Won No. 707* is the third of four ROK fishing vessels that have been seized for violating U.S. fishing laws during 1976. On 9 February the *Dong Won No. 709* (621 GRT) was seized and fined $530,000 for fishing inside the U.S. Contiguous Fishing Zone (CFZ), a 12-mile limit around the coast. On 21 July the ROK stern trawler *Kyung Yang Ho* (5,377 GRT) was seized for violating CSFR laws by retaining crab and fined $575,000. The third seizure of an ROK vessel was that of the *Dong Won No. 707* on 1 August. A fourth ROK vessel, the longliner *Kwang Myong No. 21* (499 GRT), was seized 3 September for a CSFR violation. That case is still pending. Detailed reports on the seizures of the *Dong Won No. 709* and the *Kyung Yang Ho* can be obtained by requesting International Fisheries Reports 76/96 and 76/203 from the Office of International Fisheries, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235.

GERMANY REPORTS HERRING IMPORTS

The total supply of Federal Republic of Germany (FRG) herring in 1975 was 145,000 metric tons (t), compared with 149,000 t in 1974. The Common Market (EC) was the major supplier, accounting for 68 percent of all FRG imports. Canadian imports were 15.2 percent of all imports, and U.S. imports, 6.3 percent (Table 1).

Common Market exports to Germany have decreased from 114,000 t in 1973 to 77,000 t in 1975, reflecting the decline in North Sea herring stocks. Canada and the United States, during the same time period, have increased their share of the total German herring supply from 3 to 12 percent, and from 1.5 to 5 percent, respectively.

Table 1.—Federal Republic of Germany herring imports, 1973-75.

Exporting Country	Imports (mt)		
	1975	1974	1973
Common Market (EC)			
Denmark	46,822	57,080	71,755
Ireland	2,745	5,617	5,406
Netherlands	11,330	11,209	14,153
United Kingdom	12,502	14,484	17,282
Other	3,649	2,716	5,554
Total EC	77,048	91,106	114,150
Non-EC			
Bulgaria	—	260	1,141
Canada	17,428	8,964	5,227
German Democratic Republic	1,181	2,994	1,455
Iceland	706	151	621
Norway	7,087	4,199	6,238
Poland	2,404	4,524	4,802
Sweden	631	159	653
USSR	378	997	—
USA	7,270	3,381	2,611
Other	7	11	39
Total Non-EC	37,092	25,640	22,787
Grand total	114,140	116,746	136,937
Total FRG herring supply (FRG production and imports)	144,868	149,315	172,564

Source: Irish Fisheries Board.

The amount of fresh and frozen whole herrings was 45,000 t in 1975, a decline from 49,000 in 1974. Fresh and frozen butterfly fillets were 68,000 t, an increase of 5.6 percent over 1974. Imports of pickled butterfly fillets and spiced products were 3,322 t, an increase of 8 percent over 1974. Salted herring imports were 22,000 t in 1975, almost the same as in 1974. Declining herring stocks in the North Sea will probably result in increasing imports of herring. (Source: Irish Sea Fisheries Board.)

Denmark, Norway Tell New Fisheries Jurisdictions

Danish Prime Minsiter Anker Jorgensen announced on 5 October that the Government would present a proposal for a 200-mile fisheries limit for Denmark, Greenland, and the Faeroe Islands. The proposed extension would take place at various times in as yet unannounced zones at the discretion of the Prime Minister. Jorgensen explained that this method was chosen because of the uncertainties surrounding Law of the Sea negotiations and Common Market (EC) fishery policy discussions. The fisheries limit of Greenland was expected to be extended by 1 January 1977, but jurisdiction of the Faeroes depends on final negotiations with the EC over Faeroese fishing in British waters and a reciprocal fishing agreement with Norway.

The NMFS Office of International Fisheries notes that the Danes are attempting to protect the waters of the Faeroe Islands and Greenland, and at the same time retain full access for the Danish and Faeroese fleets to other nations' waters, especially Britain's.

Norwegian Prime Minister Nordli also announced on 5 October that Norway would enforce a 200-mile economic zone on 1 January 1977. Norway signed a bilateral fisheries agreement with the USSR on 15 October over Soviet fishing privileges and met with Poland and the German Democratic Republic before the end of 1976. Norway will also negotiate with the EC over reciprocal fishing rights, as it catches 25-30 percent of its catch in waters which will be included in the EC's new 200-mile limit. (Sources: U.S. Embassies in Copenhagen and Oslo.)

Bulgarian stern trawler *Ofelia* enters Oregon's Coos Bay Harbor.

Bulgarian Stern Trawler Seized Off Oregon

The U.S. Coast Guard seized the Bulgarian stern trawler *Ofelia* on 27 September 1976 for the violation of United States 12-mile Contiguous Fishing Zone (CFZ). The Bulgarian vessel was observed fishing off Cape Arago near the Oregon coast from 0.3 to 0.6 nautical miles inside the CFZ. After establishing *Ofelia's* position by radar, fathometer, and visual bearings, and observing the hauling of a trawl, the Coast Guard cutter *Venturous* sent a boarding party, including a National Marine Fisheries Service (NMFS) agent, aboard the vessel to notify the master of the seizure. The boarding party confirmed *Ofelia's* position by its own radar. The captain offered no resistance and the vessel proceeded under escort to Coos Bay, Oreg.

The *Ofelia* is a factory trawler of B-418 (II) class, built in April 1975 in Gdynia, Poland, and is owned by the Okeanski Ribolov of Burgas, Bulgaria. The crew consists of 21 officers and 82 crewmen including the captain, Hristos Popov. The vessel is equipped for bottom and pelagic trawling and also has fish processing equipment on board. In addition to five holds, of which two are refrigerated, the vessel is equipped with a 37 cubic meter fish oil tank. Only pelagic (mid-water) trawls are used in the Pacific hake fishery; the net is 95 meters wide and 165 meters long and has progressively smaller mesh (from 60 cm at the top to 5 cm at the bottom). The cod end liner measures only 2 cm per stretched mesh (or slightly over 1½ inches). The *Ofelia's* target species is hake and, at the time of the seizure, the vessel's holds contained 205 metric tons of hake fillets, 45 metric tons of headed and gutted hake and 48 metric tons of fish meal. The total value of these products was estimated at $350,000.

This is the first time that Bulgaria has sent five stern trawlers and two transport vessels to enter the hake fishery off Oregon and the *Ofelia* is one of them. The *Ofelia* arrived off the U.S. west coast on 5 September, began fishing 6 September and planned to remain in the hake fishery until 15 December 1976.

The *Ofelia's* specifications are as follows:

Gross Registered Tons	2,467
Draft	17 feet
Length	292 feet
Width (Beam)	49 feet
Speed (Max.)	15.5 knots
Engine (6 cyl. diesel)	3,600 hp
Endurance	80 days

Civil action was filed against the Bulgarian captain on 28 September and the hearing took place on 6 October in U.S. District Court, Portland. On 7 October, the captain was fined $5,000 and sentenced to a year of unsupervised probation. The civil suit was settled out of court and a fine of $350,000 was imposed. The fine to the captain ($5,000) and moorage charges were deducted from the total sum. After payment of the fine, *Ofelia* was released and escorted out of Coos Bay on 18 October. Three crewmen from the Bulgarian vessel requested political asylum on 13 October. The U.S. Immigration and Naturalization Service granted their request.

The *Ofelia* is the first foreign vessel seized off the Oregon coast as well as the first Bulgarian vessel seized off the west coast. (Source: Enforcement Division, NMFS, NOAA.)

West African Nations Eye LOS Common Front

The ministers having responsibility for marine fisheries from Senegal, Mauritania, Guinea-Bissau, Gambia, and Cape Verde met on 14-16 October 1976 in Dakar (Senegal) to discuss common problems in their fisheries and the need for cooperation. A major concern expressed by the ministers was the protection of fishery limits from poaching by vessels of the developed countries.

Andrien Senghor, the Senegalese Minister of Rural Development and Water Resources, who presided over the Conference, stressed the importance of developing national fishing fleets and fishing industries. He stated that the Senegalese fishing industry is currently working at only 70 percent of its capacity. He also emphasized that West

African countries must develop their own statistics on foreign catches within their fishing limits, because the available statistics (which indicate a catch of 1.2 million tons) are not realistic and should be "at least three times as much". The question of adequate means for enforcement was also stressed. In Senegal, which claims a 200-nautical-mile fishing zone, the Navy is responsible for enforcement. Senegal reportedly does not now have means to strictly enforce this limit. However, Senghor stated that his Navy's capability will be increased by new patrol vessels and planes. He reportedly spoke out against "looting of our marine resources by Eastern as well as Western industrialized countries."

Three task forces studied: 1) the exploitation of the fishery resources; 2) the status of fisheries development in the region; 3) the management and conservation of the resources; and 4) the Law of the Sea aspects, including enforcement. The need for cooperation in all these areas was found essential.

A communique was issued which mentions, in addition to the above four points, the need for the increased interchange of commercial and technical information, the development of artisanal fishing industries, and a call for the coordination of the fishing legislation of the five West African countries. The conference proposed a meeting of experts to "present a common front on the Law of the Sea," and the formation of a Coordinating Committee with a Permanent Secretariat. The next conference will be held in 6 months in the Gambia which will be responsible for making the arrangements, while Senegal will continue to provide the services of the Secretariat.

Taiwan Readies Purse Seine Fleet Expansion

The Taiwanese Government is helping its fishing industry to make a large investment for the construction of 20 fleets of large, steel purse seiners and support vessels. Each new fleet will have 5 vessels: one purse seiner (150 GRT), two light-carrying vessels (50-60 GRT), and two refrigerated fish carriers (150-200 GRT). A total of 100 vessels will be built.

The first fleet of five vessels, ordered by the Shuan Tien Fishing Company, is being built by the Suao Shipyard, located on the

east coast of Taiwan between Keelung and Hualien (see map). The vessels were scheduled to be completed before the end of 1976.

In recent years, Japanese vessels have been fishing in the coastal waters off eastern Taiwan in the East and South China Seas and selling their eatch in Taiwanese fishery markets. The Taiwanese Government and the fishing companies, therefore, decided to build the seiner fleets in order to develop their own coastal fishery. (Source: *Economic Daily News.*)

Taiwanese vessels have made consistently good catches in the newly discovered fishing grounds off Australia, New Zealand, in the Red Sea, in the South and North Pacific, and along the southwestern coast of Africa. The Taiwanese Government is actively studying such migratory species as mackerel, skipjack, pompano, etc. The Government also learned that the Antarctic Ocean is abundant in krill and sent the *Hai Kuong*, a research vessel, to conduct exploratory research in November 1976. (Source: *Lien Ho Pao, Chung Yung Tzu Pao.*)

According to the NMFS Office of International Fisheries, the Taiwanese Government and the Joint Commission on Rural Reconstruction will provide financial assistance to the fishing companies which will order the 20 seiner fleets with 100 fishing vessels. The projected date of completion will be within the next 5 years and most likely by 1980. The average catch per fishing day of each fleet is estimated at about 40-50 metric tons (t), or 200,000 t per year. (The average fishing days per year were calculated at 200 days.) The fleets will fish in the East and South China Seas and expand their operations to the north and South Pacific oceans by 1985.

Canada Will Expand Fishing, Sport Boat Harbors

Second reading was given 10 December 1976 in Canada's Parliament to Bill C-7 "The Fishing and Recreational Harbours Act". The new Act, which is to be administered by the Fisheries and Marine Service of Fisheries and Environment Canada, is designed to provide for the development and administration of some 2,300 fishing and recreational boat harbors.

"The Act is aimed at meeting the changing requirements of the commercial fisheries and the growing needs of sports fishing and recreational boating," said Roméo LeBlanc, Minister of Fisheries and the Environment. Legislative authority for administration of these harbors is currently provided by the Harbours and Piers Act and its accompanying Wharves Regulations, originally drafted in 1895 and revised in 1937.

Administratively, the present Bill contains enabling provisions which will allow the Minister to manage and maintain harbors under his jurisdiction, to make and enforce regulations, and to prescribe and collect charges for the use of harbors. At the present time, the majority of harbors and wharves have no day-to-day supervision, an inadequate fee structure, and minimal enforcement of regulations.

"I intend to introduce an effective management system, which will be flexible and responsive to the needs of fishermen. Harbor managers will be given the authority required to properly manage their harbors and facilities, and will be provided (by subsequent regulations) with adequate means of enforcement," said LeBlanc.

Under the new Act the provision of harbors and associated facilities for recreational boating, such as marinas and launching ramps, will emphasize joint planning and cooperation with the Provinces. Construction, operation, and maintenance of facilities providing access to the water, such as launching ramps, will be mainly the concern of provincial and municipal governments with the federal government propos-

ing some cost sharing arrangements to encourage this type of development. Regulations governing fee structure and other details of the Act were expected later.

PERUVIAN ANCHOVY FISHERMEN STRIKE

Peru's anchovy fishermen struck 18 October to oppose the Peruvian Government's program of reducing the operating deficit of PESCAPERU, the Government-owned fish meal company. The fishermen were especially critical of the Government's proposal to sell most of the nationalized anchovy fleet to private owners and groups of PESCAPERU's former employees.

Peruvian press reports of successful anchovy fishing off that country's coast, however, indicate that anchovy fishermen are gradually going back to work. The Government-controlled newspapers reported on 9 November that some 145 fishing boats went to sea the day before, catching a record 15,000 metric tons of "exceptionally large anchovies."

The fleet was reportedly made up of 37 vessels owned by PESCAPERU and of 108 vessels owned by the newly formed small cooperative fishing enterprises. More recent reports indicate that as many as 170 vessels were fishing on 14 November, or 25 more than 5 days earlier. The 170 vessels were manned by 3,000 fishermen, or about 30 percent of the total labor force in the anchovy fishery. One-third of the fishing vessels based in Callao were reportedly fishing and the fish meal factories in that port were then operating at full capacity.

The Comite de Coordinacion y Unificacion Sindical Clasista (CCUSC) announced in a press conference on 9 November, that PESCAPERU and the representatives of the Federacion de Pescadores de Peru (FPP, the Peruvian Fishermen's Federation) began direct talks on 8 November. The Secretary General of the FPP, Claudio Nizama, was participating in the talks even though he was still officially "detained" by the Government. The FPP demands, revealed during the press conference, were: 1) Respect for the labor guarantees previously achieved by the FPP; 2) a 250,000 soles (approximately US$3,730) indemnity to all fishermen who, for any reason, are separated from PESCAPERU. This would include all of PESCAPERU's former employees, even those who choose to purchase the company's vessels and form small cooperatives; and 3) an end to all repressive measures against the strikers and their supporters, and release of all FPP members detained by the Government.

Striking fishermen are especially bitter toward those fishermen who have returned to work. In early November, bombs were placed at the homes of seven such fishermen in Lima and northern Peruvian ports. No one was injured although some property damage was reported. In some cases, threatening notes were left behind. In addition, the homes of other working fishermen had been vandalized. These terrorist tactics have reportedly been launched by a group calling themselves the Miguel Gran Command.

The Peruvian Minister of Fisheries, Rear Admiral Francisco Mariategui, has called the attitude of some FPP members "unpatriotic and negative." He indicated that the Government was losing 250 million soles (approximately US$3.7 million) each day of the strike.

The Peruvian Government showed some signs of acommodation with the striking fishermen. The FPP's President, Carlos Blas Robles, was released from custody to participate in the talks with Government officials.

On the other hand, the Government adopted various measures designed to entice the wavering fishermen, or those experiencing economic difficulties, away from the FPP and back to work. The Government announced on 13 November that striking fishermen would be given another chance to register to go back to work. Fishing on Sunday, generally prohibited by law, was authorized. Also, instead of weekly payments based on the landed tonnage, PESCAPERU began paying the small cooperatives for their catch as soon as it was delivered. In addition, the Government also took a number of administrative actions against the FPP. The Ministry of Labor has announced that FPP leaders will no longer be recognized by the Government as the legal representative of the fishermen because the strike violated the state of emergency declared in July. The Ministry's statement added that FPP leaders would be held responsible for the strike and the acts of terrorism which have been committed. (Source: U.S. Embassy, Lima.)

According to the NMFS Office of International Fisheries, the Peruvian Government had probably not completely recovered by late November from the economic damage experienced in the first few days of the strike. But, with the reported record anchovy catches and a gradually increasing number of fishermen reporting to work, the detrimental impact of the fishermen's strike was definitely reduced. Government willingness to deal directly with FPP representatives and the release of several detainees were positive signs, but the FPP's demands and the Government position, dictated by harsh economic realities, were still apparently miles apart. The Government-owned daily newspaper *La Cronica* reported on 12 November that PESCAPERU and the Federacion de Trabajadores Pesqueros del Peru (FETRAPEP) had signed an agreement on salary increases. The implication was that a solution to the strike has been found. However, FETRAPEP appears to be a "sweetheart" group without significant support among PESCAPERU's 9,000 fishermen, many of whom remain on strike.

JAPANESE FISHERY PLANS TRANSLATED

The following reports are abstracts of translated articles and full translations recently produced by the Language Services Branch, F412, of the National Marine Fisheries Service (NMFS). Copies of complete translations of the abstracted material are available from the Language Services Branch, F412, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235.

An article in *Suisan Shimbun* (No. 3718, 21 April 1976) summarizes the latest available annual report, commonly called the "Fisheries White Paper," of the Fisheries Agency of Japan. The article discusses such major topics as the trend in supply of fisheries products in Japan, the trend of moderate fish price increases, changing circumstances surrounding the fishing industry, financial difficulties confronting fishing companies, and future of the fishing industry. Thirteen statistical tables, two graphs and one map from the White Paper are included. The article also incorporates some responses of industry spokesmen to the government's report, as well as an enumeration

of government programs currently in effect.

The Soviet Union and the Peoples Democratic Republic of Korea (North Korea) have offered to sell Alaska pollock "surimi" to Japan, according to a *Minato Shimbun* (No. 8772, 19 September 1976) report. The offers were tendered to the National Federation of Kamaboko Producers Cooperatives in September 1976. The Federation, whose members are faced with shortages of kamaboko raw materials, was seriously considering the offers. The Japanese Government limits the quantity of Alaska pollock "surimi" imports through the "Import Quota" (IQ) system and Kamaboko producer associations were planning to lobby for removal of "surimi" from the IQ list when the raw material supplies dwindled further. The Soviets are currently producing "surimi" and can become a ready supplier to the Japanese kamaboko industry. Whether the North Koreans produce Alaska pollock "surimi" at present is not known; however, their total annual catch of Alaska pollock is reportedly 1,000,000 metric tons. (Complete translation.)

Morphological examinations and tagging experiments for identifying several groups of Brydes whales inhabiting Japanese offshore areas are discussed in an article in *Geiken Tsushin* (No. 288, August 1975) by Y. Masaki. Although Brydes whales have been harvested by the Japanese since ancient times, they were not distinguished from sei whales until 1955. In 1955, the "Japan Whaling Statistics" began to list Brydes whales and sei whales separately, calling the former "southern sei whales," a misleading name, which has since been replaced by "nitari kujira." Four groups of Brydes whales are commonly recognized in Japanese offshore waters. They are found in the following regions: off Sanriku; west of Kyushu; Bonin Islands and north Pacific areas. Masaki claims no success in establishing each of these groups as a subpopulation in the biological sense.

The semi-governmental Japan Marine Fisheries Resource Research Center published its latest activities report on 15 August 1976 notes *Suisan Shuho* (No. 781, 15 September 1976). The Center employs 11 vessels to experimentally harvest in eight types of fisheries in more than a dozen locations throughout the world. The most noteworthy result of these efforts comes from off Nova Scotia, where the center-chartered *No. 63 Hoyo Maru* has caught 272.7 t of squid to date. The catch amounted to 98 percent of the target for this survey scheduled to end in early December 1976.

On the other hand, the greatest disappointment came from skipjack fishing in the Oceania region of the Pacific. The purse seiner *Nippon Maru* caught only 28.5 t of tuna, a scant 2.6 percent of the 1,112 t goal set by the center. According to the center director, the center was asked by the Argentinean Government to study fish resources off Patagonia. In response to this request, the center planned to dispatch the purse seiner *No. 1 Orient Maru* to that region in 1977. The center is also planning to conduct, at the cost of 700 million yen ($2.3 million) a survey off the Chilean coasts this year. The Agriculture and Forestry Ministry is proposing a 4,080 million yen ($13.5 million) subsidy to the center for FY77.

The Fisheries Agency of Japan has published details of a proposed sixth Five-Year Plan for 1977-81 to improve 1,270 fishing harbors, according to a report in *Suisan Shuho* (No. 781, 15 September 1976). The agency maintains that a continuation of extensive renovation work on harbors is necessary in order to establish modern and attractive bases of operation for fishermen, improve fishing villages and towns where families of fishermen live, and help ensure a stable supply of fish as important sources of food for the nation. The agency assesses the importance of each fishing harbor according to the contributions it makes in: 1) fish harvesting; 2) catch distribution; 3) community life and non-fishery industry development at or near the harbor; and 4) navigational safety.

The total cost of the sixth Five-Year Plan is estimated to be 1,400 billion yen ($4,666 million), which is nearly twice as much as the fifth Five-Year Plan to be completed in December 1976. In the new Five-Year Plan, harbors important to Japanese coastal fisheries receive top priority with 50 percent of the entire budget earmarked for them. Harbors serving inshore fisheries receive the second priority by receiving 16 percent of the budget (Complete translation.)

Japan Will Reduce Tuna Fleet 20 Percent

The Federation of Japan Skipjack and Tuna Fisheries Cooperative Associations, with the support of the Japanese Government, has inaugurated a 3-year program designed to reduce the current tuna fleet of 1,300 vessels by 20 percent. The plan calls for the removal of 65 vessels from the tuna fleet in 1976, 130 in 1977, and 65 in 1978. Some of these vessels will be used in the squid and other fisheries, and the remaining vessels will be scrapped. Loans and subsidies have been appropriated to help cover either the costs of diverting the ships to other fisheries, or of scrapping the remaining vessels. The plan has been necessitated by increased South Korean and Taiwanese tuna exports to Japan, according to Japanese sources. Faced with higher catch rates on the part of the Taiwanese and Koreans, together with lower labor costs, the Japanese tuna industry is losing its competitive advantage, even on the domestic market.

According to the NMFS Office of International Fisheries, the United States and Japan provided South Korea with financial assistance during the 1950's to stimulate the Korean tuna industry. In 1957, Korea began its first experimental operation of tuna longliners. In 1962 Korea had a tuna fleet of five Japanese-built longliners; by 1967 Korea had increased this to 170 vessels which took about 40,000 metric tons (t) of tuna annually. In 1972 Korea's fleet totaled 360 tuna vessels, taking 97,670 t of tuna. The catch in 1973 was 105,723 t and in 1974 reached 106,921 t. The Japanese, with a huge pelagic fleet of 1,300 vessels, landed 572,026 t of albacore, bluefin, yellowfin, bigeye tuna, young tuna, skipjack, and other tuna-like species in 1972 (Tables 1 and 2).

Although Japanese tuna catches have remained consistently high, the overall efficiency of Japanese pelagic tuna operations, compared with that of South Korea, has been declining in recent years. The efficiency of tuna longliners is measured in terms of the number of fish caught per 100 hooks. The Japanese rate of catch per 100 hooks has been decreasing, necessitating longer pelagic expeditions. In that the over-

all costs of fuel, gear, and salaries have risen dramatically since 1974, extended voyages are doubly costly to the tuna industry. In contrast, South Korea's rate of catch per 100 hooks has been rising, enabling higher catches in a shorter time period. This, together with overall low labor costs, allows South Korea to market its tuna at a price far below Japanese competitors.

Japan imported about 50,000 t of tuna from Korea, valued at US$68 million in 1975, or about 55 percent of total tuna imports of 90,900 t (Table 3). Japan exported about 137,800 t of frozen tuna in 1974, much of which was exported to the United States and Puerto Rico, where it was processed and canned. Japan also exported about 45,800 t (producer weight) of canned and processed tuna in 1974, primarily to the United States, the European Community, and Canada.

Frozen round tuna exports declined to 32,400 t in 1975, only 24 percent of the quantity exported by 1974, due to a sharp fall in U.S. demand. Exports of canned and processed tuna rose to 46,800 t in 1975, an increase of approximately 2 percent (Tables 4 and 5).

Faced with a worsening situation on the domestic market, the Japanese tuna industry pressed the Government to hold private negotiations with the Koreans in an attempt to set tuna import quotas. The Koreans, fearing major quotas would be established by the Japanese, agreed to a voluntary quota of 45,000 t per year in June 1975. This action did not solve the Japanese domestic market problem. A further proposal was made in late 1975, calling for a duty-free limit of 70,000 t of tuna with a 20-25 percent duty on larger quantities. The Koreans reacted severely to this proposal by threatening to withdraw Japanese fishing rights within Korean waters. (Sources: *Australian Fisheries* and *Fishing News International*.)

Table 1.—Republic of Korea's 1970-74 tuna catch.

Year	Catch (mt)
1970	[1]71,363
1971	[1]83,784
1972	[1]97,670
1973	[1]105,723
1974	[2]106,921

[1]ROK Office of Fisheries, "Yearbook of Fisheries Statistics," 1974.
[2]FAO, "Yearbook of Fisheries Statistics," 1974.

Table 2.—Japan's 1970-74 tuna catch (metric tons).

Year	Albacore, other tunas[1]	Skipjack, tuna-like species[2]	Totals
1970	291,017	231,901	522,918
1971	307,965	191,656	499,621
1972	318,090	253,936	572,026
1973	341,818	356,343	698,161
1974	348,950	373,573	722,523

[1]Includes albacore, bluefin, yellowfin, bigeye tuna, and young tunas.
[2]Includes skipjack and frigate mackerel *(Auxis thazard)*. Source: Japanese Ministry of Agriculture and Forestry, "Gyogo Yoshokugyo Seisan Tokei Nempo," 1976.

Table 3.—Japan's tuna imports, 1974-May 1976, by quantity (1,000 mt) and value (US$ million).

	1976		1975		1974	
From	Quantity	Value	Quantity	Value	Quantity	Value
Korea	24.0	41.0	50.1	67.9	28.9	36.5
Taiwan	3.7	8.6	19.4	27.0	9.9	14.1
USA	0.1	0.04	1.2	2.8	0.2	1.2
Others	7.0	4.7	20.2	16.5	7.7	8.0
Total	34.8	54.3	90.9	114.2	46.6	59.8

Source: Japanese Ministry of Finance, "Japan Exports and Imports: Commodity by Country," 1974, 1975. Published by the Japan Tariff Association.

Table 4.—Japanese exports of frozen round tuna, 1974-75.

	1975		1974	
Country	Quantity	Value	Quantity	Value
	1,000 mt	*US$ million*	*1,000 mt*	*US$ million*
USA	2.8	1.3	59.0	45.8
Puerto Rico	6.5	3.0	37.0	20.0
Canada	0	0	0	0
European Communities	<0.5	<0.001	5.1	5.2
Others	23.1	6.3	36.7	12.0
Total	32.4	10.6	137.8	83.0

Source: Japanese Ministry of Finance, "Exports and Imports: Commodity by country," 1974, 1975. Published by the Japan Tariff Association.

Table 5.—Japanese exports of canned and processed tuna, 1974-75.

	1975		1974	
Country	Quantity	Value	Quantity	Value
	1,000 mt	*US$ million*	*1,000 mt*	*US$ million*
USA	19.9	40.8	19.5	43.3
Puerto Rico	0	0	0	0
Canada	6.8	14.9	6.7	16.1
European Communities	12.4	22.1	10.2	20.5
Others	7.7	15.4	9.4	20.0
Total	46.8	93.2	45.8	99.9

Source: Japanese Ministry of Finance, "Exports and Imports: Commodity by country," 1974, 1975. Published by the Japan Tariff Association.

Icelandic Firm X-rays Fish Blocks for Bones

The Icelandic Freezing Plants Corporation, also known as SH, is now X-raying fish blocks to improve the quality control of its frozen fish exports which are mainly shipped to the United States, according to the NMFS Office of International Fisheries.

Quality control of frozen fish products for the U.S. market has been difficult to implement. To spot check the production of frozen blocks it has been necessary to thaw out the fish to ascertain its quality. The X-ray equipment, which both X-rays fish blocks and immediately produces the picture of the product, makes control more extensive and more reliable as it reveals the bones remaining in the fish block. A special vehicle, owned by SH, now takes this equipment throughout Iceland and the blocks are X-rayed in all of the corporation's freezing plants.

Halldor Gislason, an SH engineer who developed the X-ray technique, had originally hoped that it would be possible to also reveal parasites in the products on the X-ray pictures, but that hope failed. However, fish bones can be clearly seen. It is hoped that this new technique can be further developed

so that a great number of fish blocks could be X-rayed at once and rapidly without unwrapping the product. Gislason also stated that there are no health dangers from the radiation. "Soft" X-rays and short exposure time produce no more radiation than the fish receive in a 6-month period from natural radiation sources.

World Fisheries Developments Listed

The Division of International Fisheries Analysis, which follows trends in world fisheries for the National Marine Fisheries Service (NMFS), has prepared the following summary of the recent developments in world fisheries.

Japan's Fisheries Agency changed its Director-General on 5 November 1976. Makoto Okayasu replaced Hoshihide Uchimura as head of the Agency. In a press conference on 5 November, Uchimura spoke of "imminent adversity," an apparent reference to extensions of fishery jurisdictions.

Ambassador Malcolm Toon has been selected by the White House as the new U.S. envoy to the Soviet Union. Toon, a career diplomat, replaces Walter J. Stoessel, Jr., who left Moscow because of health problems and is now Ambassador to the Federal Republic of Germany.

U.S. and USSR representatives on 26 November 1976, signed a Governing International Fisheries Agreement (GIFA) relating to fishing activities of the Soviet Union off the U.S. coasts.

Mexico and the United States signed a fisheries agreement on 26 November 1976, in Mexico City. The agreement establishes fees and catch limits for U.S. fishermen who wish to operate in the 200-mile Exclusive Economic Zone claimed by Mexico.

Japan's prestigious newspaper, the *Asahi Shimbun,* on 15 November criticized the "stubborn" U.S. position regarding establishment of a 200-mile fishing zone and, in a strongly worded editorial, called for Government-industry contact with President-elect Carter and an appeal to the American people. According to the paper, the U.S.-Japan fishery negotiations had ended in failure and nothing more could be accomplished at the working level.

Japan's Communist Party demanded on 12 November that the Japanese Government declare a 12-mile territorial sea. On the same date, the JCP presented a request to the Soviet Ambassador in Tokyo for his Government to take effective measures to implement the June 1975 bilateral agreement on fishing operations and thus promote friendly relations between the Soviet and Japanese people.

The Australia-Japan fishery agreement, set to expire on 27 November, was extended by Australia for 2 months, until 26 January 1977. The extension allowed both countries to discuss outstanding fishery issues after Japan's general election on 5 December, and during their bilateral ministerial talks scheduled for Tokyo in January.

Norway and the Common Market (EC) held two rounds of discussions in Brussels in November on reciprocal fishing privileges in each other's fishery jurisdictions.

A Polish Parliament committee, the Sejm, has studied the national fisheries marketing program to determine the volume of catch needed to satisfy rising consumption: from 7.2 kg per capita in 1976 to an estimated 10 kg in 1980. Limitations on fishing imposed by the extension of fishing limits by many countries will require a search for new fishing grounds and species.

Mexico and COMECON (Council on Mutual Economic Assistance) held the first session of their Joint Commission for Cooperation in Moscow on 19-20 October. An agreement was reached to create a working group for fishery problems.

Peru's anchovy catch through 24 November 1976, amounted to 3.3 million t, exceeding the 1975 catch of 3.1 million t. During this same period in 1976, over 710,000 t of fish meal and 70,000 t of fish oil were produced.

Though Peru's fishermen's strike continued, many fishermen went back to work and 88 anchovy seiners were operating on 2 November. The number of vessels increased to 176 on 17 November, but declined to 144 on 24 November. The average Peruvian anchovy seiner can catch approximately 250 t of fish per trip.

The Peruvian Ministry of Labor warned striking anchovy fishermen that their strike was illegal because a state of emergency, proclaimed in July, still existed. Peruvian school teachers staged a strike on 17 November in support of the fishermen.

Iceland's Marine Research Institute has recommended that no more than 275,000 t of cod be taken annually from Icelandic waters in 1977 and 1978. The 1976 cod catch is estimated to be about 340,000 t.

Norway's Foreign Minister met with France's Foreign Trade Minister and other officials in Paris on 24-25 October to discuss French-Norwegian economic cooperation. Among the topics discussed were a fisheries agreement and the French fishery in the waters off Norway and Spitzbergen.

Norway's Fisheries Minister, Eivind Bolle, met with the chairman of the Polish Council of Ministers, Piotr Jaroszewicz, in late November to discuss Polish-Norwegian fisheries cooperation.

Iceland's trade agreements with Czechoslovakia and Poland have been renewed for another year with no significant changes. Considerable quantities of frozen fish fillets are shipped to Czechoslovakia, while Poland buys fish meal and salted herring.

Canadian Maritime Province landings in the first 9 months of 1976 were 366,000 t, valued at $107.2 million. Landings for the same period in 1975 were 373,000 t, valued at $91 million.

Japanese seafood importers contracted to buy about $17 million worth of shrimp, other shellfish, and finfish from the People's Republic of China at the Canton Trade Fair. Details of the contract and names of the Japanese companies were not reported, but according to a Japanese source, a contract for 1,200 t of shrimp at about $10,000 per ton was signed.

Japan's Minister of Agriculture and Forestry on 21 November ordered a study aimed at increasing Japan's food imports and lowering tariffs following criticism from the EC about Japanese trade policies. An EC joint message delivered in Brussels on 16 November called upon Japan to revise its trade policies and redress a trade imbalance which is now in Japan's favor.

Two Japanese trawlers began exploratory fishing off Bangladesh in the Bay of Bengal on 14 October. Under an agreement with the Government of Bangladesh, two private Japanese companies will pay for this trial operation.

Prime Ministers of Sri Lanka and Japan met in Tokyo on 17 November and the Japanese Government agreed to extend loans for a fishing gear factory and other development projects in Sri Lanka.

Thailand has proposed that a fishery joint venture with Indonesia begin in January 1977 with a 4-month survey of marine resources. The joint venture is a result of Government-level talks, but it will be operated by private companies in the future.

The USSR received the 185th and last *Atlantik*-class freezer factory trawler from the German Democratic Republic (GDR) on 24 October 1976. The *Atlantik*-class, developed by the GDR and USSR, was in production for 10 years. The 3,200 gross-register-ton trawlers were also exported to Romania, Bulgaria, and Cuba.

Two Soviet whaling flotillas left for Antarctica: the Sovetskaia Ukraina on 16 October, and the Sovetskaia Rossiia on 21 October. The trip will last about 7 months.

Polish and Danish scientists are conducting joint research to expand the supply of marine foods. The results of the studies will be used in the determination of fisheries policy and in marine culture programs.

The average price index of fishery products in Poland during 1970-75 remained steady despite a 59 percent increase in average salaries. Heavy government subsidies to the fishing and food industries ($6 billion annually) account for low prices. Recently proposed increases in food prices were strongly protested by Polish consumers and were subsequently withdrawn.

Per capita consumption of fishery products in Poland nearly doubled during 1960-75, from 4.5 to 7.2 kg. Consumption of marine fish increased by 60 percent from 4.0 to 6.4 kg, while per capita consumption of salted herring decreased by 50 percent.

Libya is placing a high priority on the development of its marine fisheries during the 1976-80 planning period. A special council has been established under the Ministry of State for Nutrition and Marine Resources for this purpose.

Angola's fishing fleet has been greatly reduced due to the Civil War disturbances and natural disasters. Recent reports indicate that the only fishery commodity available in the Luanda markets is squid and even that only irregularly. There have been no known deliveries of fish from the Cuban and Soviet trawlers which operate in the southern Atlantic.

Russia Tells U.S. Pacific Coast Fish Catch

The All-Union Scientific Research Institute of Marine Fisheries and Oceanography in Moscow has provided the National Marine Fisheries Service with preliminary catch statistics for fishing areas off the U.S. Pacific Northwest, California, and Alaska (see table).

For the first 8 months of 1976, Soviet fishermen reported a total catch of 415,279 metric tons (t). This total is 7,300 t, or 1.7 percent, less than for the comparable period in 1975. The Alaska pollock fishery provided the largest proportion of the catch, 175,205 t (42 percent). The Pacific hake fishery off Washington, Oregon, and California was also significant, with a recorded catch of 127,041 t, or 31 percent of the total.

In the first 8 months of 1975 the hake fishery amounted to 37 percent of the total, while Alaska pollock made up only 34 percent. Rockfishes, Atka mackerel, flounders, cod, herring, halibut, and incidental catches of unspecified fish account for the remaining 27 percent. The Soviet fleet has been fishing pollock off Alaska since the beginning of 1975; the hake fishery off California began in March 1975.

Soviet preliminary fisheries catch off the U.S. Pacific coast, January-August, 1976.

Species	Percentage of total catch	Fishing area	Quantity in metric tons	Percentage by fishing area
Alaska pollock	42.0%	E. Bering Sea	152,135	86.8%
		Aleutian	3,073	1.8
		Western Alaska	19,286	11.0
		Eastern Alaska	711	0.4
		Total	175,205	100.0
Pacific hake	31.0	Wash., Oreg., Calif.	127,041	100.0
Flounders	6.7	E. Bering Sea	26,067	93.1
		Aleutian	271	0.9
		Western Alaska	1,444	5.2
		Eastern Alaska	110	0.4
		Wash., Oreg., Calif.	122	0.4
		Total	28,014	100.0
Rockfishes	6.3	E. Bering Sea	14,377	54.9
		Aleutian	6,691	25.5
		Western Alaska	3,370	12.9
		Eastern Alaska	133	0.5
		Wash., Oreg., Calif.	1,633	6.2
		Total	26,204	100.0
Atka mackerel	4.8	E. Bering Sea	674	3.3
		Aleutian	10,338	50.9
		Western Alaska	8,978	44.2
		Eastern Alaska	304	1.5
		Total	20,294	100.0
Cod	3.2	E. Bering Sea	12,046	88.4
		Aleutian	228	1.7
		Western Alaska	1,275	9.4
		Eastern Alaska	75	0.6
		Total	13,624	100.0
Herring	1.7	E. Bering Sea	7,226	100.0
Pacific halibut	0.02	E. Bering Sea	47	66.2
		Aleutian	2	2.8
		Western Alaska	22	31.0
		Total	71	100.0
Other, not otherwise specified	4.2	E. Bering Sea	11,390	64.7
		Aleutian	397	2.3
		Western Alaska	3,887	22.1
		Eastern Alaska	124	0.7
		Wash., Ore., Calif.	1,802	10.2
		Total[1]	17,600	100.0
Grand total[1]	100.0		415,279	

[1]Totals may not add because of rounding.

New NMFS Scientific Reports Published

The publications listed below may be obtained from either the Superintendent of Documents (address given at end of title paragraph on affected publications) or from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Writing to the agency prior to ordering is advisable to determine availability and price, where appropriate (prices may change and prepayment is required).

NOAA Technical Report NMFS SSRF-699. Ingraham, W. James, Jr., and James R. Hastings. **"Seasonal surface currents off the coasts of Vancouver Island and Washington as shown by drift bottle experiments, 1964-65."** May 1976. 9 p.

ABSTRACT

Release of a total of 1,044 drift bottles during four periods from April 1964 to January 1965 off the coasts of Washington and Vancouver Island, British Columbia, indicate a seasonal reversal of flow, southward in April and July and northward in November and January, within 200 km (108 nautical miles) of the coast. This study supplements those conducted off the Oregon and California coasts by other agencies.

NOAA Technical Report NMFS CIRC-394. Pollock, Leland W. **"Marine flora and fauna of the northeastern United States. Tardigrada."** May 1976. 25 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

The manual includes an introduction to the general biology, an illustrated key, an annotated systematic list, a selected bibliography, and an index to the Tardigrada of the marine coastal areas of the world to a depth of 5,000 m.

NOAA Technical Report NMFS CIRC-395. Hunter, John R. (editor). **"Report of a colloquium on larval fish mortality studies and their relation to fishery research, January 1975."** May 1976. 5 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

One of the critical problems in fishery research today is the inability to determine how the abundance of adult fishes affect the strength of incoming year classes. The report summarizes the discussions of experts on how studies of larval fish mortality may assist in solving this problem. Included in this report are discussions of the principle causes of larval mortality and their possible relation to stock size. Guidelines and recommendations are made regarding future research on the mortality of larval fish.

NOAA Technical Report NMFS SSRF-700. Cook, Steven K. **"Expendable bathythermograph observations from the NMFS/MARAD Ship of Opportunity Program."** June 1976. 13 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

Results of the third year of operation of the NMFS/MARAD Ship of Opportunity Program are presented in the form of vertical distributions of sea surface temperature and salinity. Included are descriptive analyses of the most dynamic transects showing the Caribbean/Yucatan/Loop/Florida Current regimes, the Gulf Stream, associated eddies, and the bottom cell of cold water off the U.S. east coast. Operational and data management procedures also are discussed.

NOAA Technical Report NMFS SSRF-701. Houde, Edward D., and Nicholas Chitty. **"Seasonal abundance and distribution of zooplankton, fish eggs, and fish larvae in the eastern Gulf of Mexico, 1972-74."** August 1976. 18 p.

ABSTRACT

Zooplankton volumes and abundance of fish eggs and fish larvae were determined for stations on 12 cruises to the western Florida continental shelf. Contour charts of zooplankton volumes and of ichthyoplankton abundance are presented. A marked seasonality was observed for zooplankton and ichthyoplankton, highest zooplankton volumes and ichthyoplankton abundance occurring during May through September. Zooplankton volumes were highest and spawning by fishes most intense in the northern half of the study area (north of lat. 27°15′N). Fish larvae abundance (number under 10 m^2 of sea surface) was highest at stations deeper than 50 m. Simple correlations among biological variables showed fish egg abundance-zooplankton volumes and fish egg abundance-fish larvae abundance to be positively correlated on most cruises. No clear relationships were observed between abundance or concentration of biological variables and temperature or salinity.

NOAA Technical Report NMFS SSRF-702. Sakagawa, Gary T., Atilio L. Coan, and Eugene P. Holzapfel. **"Length composition of yellowfin, skipjack, and bigeye tunas caught in the eastern tropical Atlantic by American purse seiners."** August 1976. 22 p.

ABSTRACT

Sampling and analytical procedures that are used to estimate the size composition of Atlantic tunas caught by American purse seiners in the eastern tropical Atlantic are described. The procedures are based on a stratified, two-stage subsampling model. Estimates indicated that about 0.2 to 1.4 million yellowfin tuna, *Thunnus albacares*, 1.2 to 12.8 million skipjack tuna, *Katsuwonus pelamis*, and 0.5 to 41.2 thousand bigeye tuna, *T. obesus* were caught annually by the fleet in 1968-74. The dominant age group in most years was 1-yr olds for yellowfin and skipjack tuna and 2-yr olds for bigeye tuna.

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